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A MONTE CARLO COMPUTER PROGRAM FOR ASSESSING CW CASUALTY RATES USING AN IBM 704 COMPUTER SYSTEM

by

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FOREWORD

Contract Agreement No. CP-0-405-992 was established between the Mathematics Branch, Weapons Research Division, Army Chemical Center, and the Computation Laboratory, National Bureau of Standards, on July 23, 1959. Extensions of the agreement to provide additional time and funds were made in December 1959, June 1960, September 1960, and January 1961. The work was completed in February 1962.

Disposition

When this document has served its purpose, DESTROY it. DO NOT return to U. S. Army Chemical Research and Development Laboratories.

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APPENDICES

Introduction

The primary purpose of the project was the development of a computer program or complex of programs for an IBM 704 computer system to assess casualty rate resulting from attack of CW weapon systems.

The programs devised have the capability of accepting as input, or generating according to prescribed rules the following data directly associated with the casualty producing mechanisms.

(i) CW munition impact distributions,
(ii) CW munition unit concentration functions,
(iii) Impact area geometric configurations,
(iv) Target area personnel distributions,
(v) Personnel breathing functions for various activity or work levels, and
(vi) Personnel dose-response functions.

As a result of this input the program can assess casualties and express the results in several forms of output.

The general problem solved by the Monte Carlo technique can be stated: For a given CW attack on an area target with a specified CW toxic agent delivery weapon system, for a given distribution of target personnel performing at a specified activity level or work rate, find the expected distribution of casualties and the variance on this expected distribution over some specified time period.

The remaining sections of this report present the essential elements of the problem by first specifying the functions involved, and indicating how these functional relations are utilized to produce a solution.

Basic Elements

The information desired can be determined in terms of the following basic elements:

(i) The equation describing the dissemination of agent from each munition,

(ii) The position and arrival time of each munition,

(iii) The distribution of personnel,

(iv) The equations describing the breathing behavior of the personnel, and

(v) The equations describing the biological effect of the agent or the dose-response functions.

Because of the probabilistic nature of the above basic elements, a Monte Carlo simulation was indicated. In general, Monte Carlo technique approximates a solution to a physical problem by means of statistical sampling. Since any of items (i) - (v) may in some cases be empirical*, it was desirable to maintain provision for optimal empirical data where applicable. This was done insofar as practicable. However, the complexity encountered in the physical, computational and statistical aspects of the problem did impose several important restrictions on the input parameters allowed by the model. Certain of these arise conceptually since the empirical data may contain implicit restrictions, but most come about for numerical or computational convenience.

*Empirical here and elsewhere in the report does not necessarily mean experimental, but rather data from some source outside the model.

Munition Distribution

The impact pattern distributions formed by weapon delivery systems fall into two general classes. First is the uniform class; a typical example of this distribution is the system consisting of large numbers of agent-filled bomblets released from a cluster or missile. Second is the class of elliptical normal distributions; a typical example of this group is toxic agent filled rocket systems. On the other hand impact co-ordinates can also be obtained directly from field tests.

In the Monte Carlo cumputer program, munition impact patterns may be either empirical or defined by specified functions over specified geometric regions. Allowable geometric configurations are rectangles and circles; Allowable impact distribution functions are uniform and circular or elliptical normal.

With respect to time, munition arrivals are either simultaneous or considered as successive sets of simultaneous arrivals occurring at specified discrete time increments. If the munition arrival points are empirical, they must lie within the prescribed configuration since many of the bookkeeping parameters are constructed as functions of the dimensions of the impact area. If the unit toxic agent dissemination function is empirical all arrival points whether read or computed are rounded to grid points.

Agent Dissemination Function

The agent dissemination function may be either empirical or analytical.

If empirical, each munition is assumed to produce a rectangular dosage pattern symmetric about the mean wind direction. Source strength, wind direction, and source strength decay are implied in this array by the values appearing and the mesh sizes assumed. The mesh sizes in the two directions may differ from each other, but both must remain of fixed size for any single computer run.

Although there are four types of agent dissemination, instantaneous and non-instantaneous for both point and volume sources, there is a single concentration function which represents all types.

The agent dissemination function defining the concentration of agent at point (X,Y) at time t for a single impact at point (ξ,η) is given, in terms of the differences;

$$x = X - \xi$$

$$y = Y - \eta$$

$$\chi(x,y,t) = \frac{2\lambda Q_o \left[1-ae^{-b\left(t-\frac{x}{\bar{u}}\right)}\right] e^{-\left[\frac{(\bar{u}t-x)^2}{k_x(t^\beta+\alpha_x)} + \frac{y^2}{k_y(t^\beta+\alpha_y)}\right]}}{\pi^{3/2}\sqrt{k_x k_y k_z (t^\beta+\alpha_x)(t^\beta+\alpha_y)(t^\beta+\alpha_z)}}$$

$\chi(x,y,t) = 0$ when $x < 0$, $t < 0$.

The agent dissemination function defining the dosage at point (X,Y) over time interval [o,T] for a single impact at (ξ, η) is given by:

$$D(x,y,T) = \int_0^T \chi(x,y,t)dt$$

The integration is approximated by a saddle-point technique and becomes:

$$D(x,y,T) = \left\{ \frac{\lambda \bar{u}^{\beta-1} Q_o \left[1-ae^{-b\left(T-\frac{x}{\bar{u}}\right)}\right] e^{-\left[\frac{\bar{u}^{\beta} y^2}{k_y(x^{\beta}+\alpha_y \bar{u}^{\beta})}\right]}}{\pi\sqrt{k_y k_z (x^{\beta}+\alpha_y \bar{u}^{\beta})(x^{\beta}+\alpha_z \bar{u}^{\beta})}} \right\}$$

$$\left\{ \operatorname{erf}\left[(\bar{u}T-x)\sqrt{\frac{\bar{u}^{\beta}}{k_x(x^{\beta}+\alpha_x \bar{u}^{\beta})}}\right] + \operatorname{erf}\left[x\sqrt{\frac{\bar{u}^{\beta}}{k_x(x^{\beta}+\alpha_x \bar{u}^{\beta})}}\right] \right\}$$

and $\operatorname{erf}(s) = \frac{2}{\sqrt{\pi}} \int_0^s e^{-z^2} dz$

Case I

If, $\alpha_x = \alpha_y = \alpha_z = 0$, $a \neq 0$

Then: $\chi(x,y,t)$ and $D(x,y,T)$ represent non-instantaneous point source dissemination functions.

Case II

If $\alpha_x \neq 0$, $\alpha_y \neq 0$, $\alpha_z \neq 0$, $a \neq 0$

Then $\chi(x,y,t)$ and $D(x,y,T)$ represent non-instantaneous volume source dissemination functions.

Case III

If $a = 0$, $\alpha_x = \alpha_y = \alpha_z = 0$. Then $\chi(x,y,t)$ and $D(x,y,T)$ represent instantaneous point source dissemination functions.

Case IV

If $a = 0$, $\alpha_x \neq 0$, $\alpha_y \neq 0$, $\alpha_z \neq 0$

Then $\chi(x,y,t)$ and $D(x,y,T)$ represent instantaneous volume source dissemination functions:

$\chi(x,y,t)$ = concentration function

$D(x,y,T)$ = dosage function.

If any α_j, for j = x,y, or z, is zero then every α_j is zero.

If any α_j, is not zero, every α_j must be non zero.

Definition, units and ranges

λ = agent recovery factor, (a numeric; $0 < \lambda < 1$)

Q_o = unit source strength (milligrams; $10 < Q_o < 10^6$)

$\bar{u}$ = mean wind speed (meters/minute; $1 < u < 10^3$)

T = time (minutes; $0 < T \leq 30$)

t = time (minutes; $0 < t \leq T$)

β = a numeric (associated with wind stability; $-2 \leq \beta \leq 2$)

k_x, k_y, k_z = agent diffusion parameters

$$(1 \leq k_x \leq 10^3;\quad 0 < k_y \leq 10^3;\ 0 < k_z < 10^3)$$

$\alpha_x, \alpha_y, \alpha_z$ = dimensions of volume source (meters; $0 \leq \alpha_j \leq 1.0$)

a,b = numerics, associated with decay of source strength.

$$(0 \leq a \leq 1.0;\ 0 \leq b \leq 10.0)$$

$\chi(x,y,t)$ = concentration at (x,y) at time t, ($\frac{\text{milligrams}}{(\text{meter})^3}$)

$D(x,y,T)$ = dosage at (x,y) for time interval (0,T), $\frac{\text{milligrams} \cdot \text{minutes}}{(\text{meter})^3}$

Personnel Distribution and Breathing Behavior

Personnel distribution on the target plane is either empirical or generated, where the generated distribution is uniform. Other distributions can be incorporated rather easily, but it was not clear that any gain would have been made in the realism of the model by so doing.

The average cumulative breathing function is computed by

$$B(T) = C_0 + C_1 T + C_2 T^2$$

where C_0, C_1, and C_2 are input parameters which are determined by the activity level of personnel involved.

For any particular computer run all personnel are assumed to be performing at the same activity level and hence have the same breathing function. The dose at a point (x,y,T) is defined as:

$$\mathcal{D}(x,y,T) = \int_0^T B(t)\, \chi(x,y,t)\,dt$$ and is approximated by

$$\mathcal{D}(x,y,T) = \bar{B}(T)\, D(x,y,T)$$

where:

$\bar{B}(T)$ = average cumulative breathing rate function.

Dose Response Functions

Three methods are available for evaluating the dose response or casualty probabilities. First the probability of a casualty P_c at a point (x,y) at time T is determined by means of a dose threshold $\mathcal{D}_o$. This method merely provides a yes-no casualty assessment for each point of the target sampled where people are assumed to be located. The number of such points with dose values $\geq \mathcal{D}_o$ is divided by the total number of points to get the fraction of casualities for a single computer run.

A second method is to form a frequency distribution of dose values over the entire target area. This frequency dose distribution is then used to compute a casualty frequency distribution by multiplying the average dose value for each class interval by its frequency and using the product to compute P_c where

$$P_c\,(c,y,T) = \int_{-\infty}^{(a_o-5) + b_o \ln \mathcal{D}(x,y,T)} \frac{1}{\sqrt{2\pi}} e^{-\frac{z^2}{2}}\, dZ$$

where a_o and b_o are parameters reflecting the virulence of the agent. A frequency distribution of P_c is then formed by counting points in the intervals

$$x < P_c \leq + .05 \text{ where } x = n(.05) \text{ where } 0 < n \leq 19$$

A third method is to compute P_c at each point (x,y) for time T and tallying the P_c in the proper class interval.

In all cases the first five moments are computed using:

$$m_r = \frac{1}{N} \sum_{i=1}^{N} \mathcal{D}_i^r$$

In cases two and three the first five moments are also calculated as follows:

$$m_r = \frac{1}{M} \sum_{i=1}^{M} P_{c_i}^r \qquad \text{for } r = 1, 2, 3, 4, 5 \text{ where}$$

N is the number of dose values on the target, $\mathcal{D}_i$ is the dose at the ith target point, and M is the number of P_c values on the target or the frequencies in the P_c distribution.

Internal Statistics of Model

For the cases in which the agent dissemination function is not replaced by an empirical pattern, the program features a self-controlling mesh size provision. Subject to an arbitrary upper limit on the number of changes possible, the program will alter the density of points in the sampling grid until the arithmetic mean threshold criterion has been met. In practice this provides for successive iterations using a varying sample point density until the successive mean values of P_c have stabilized. For the empirical pattern case this feature is not applicable because of the intrinsic geometric restrictions. The same goal may be accomplished by manual intervention to the simulation and off-machine data manipulations.

Since in individual cases input distributions are transformed into output numbers, there must be run in any Monte Carlo scheme a sufficient number of cases for the output numbers themselves to form a stabilized distribution. A discussion of the statistical design of the input and the interpretation and validity of output is beyond the scope of this report. The program does provide a tool by which the effect of various parameters may be studied. A discussion of the internal statistical aspects of the problem is in order.

The random number generation is done by the usual multiplicative scheme using the largest power of five which can be held by the computer (5^{15}) as a multiplier. Each random number of the sequence is generated as the normalized low order part of the product of the multiplier times the unnormalized preceding number from the sequence. The sequence thus produced has a period of 2^{33} or about 10^{10}.

Uniformly distributed variables are then constructed as

$$V = \mathcal{R}(V_{max} - V_{min}) + V_{min}$$

where V is the random variable, V_{max} and V_{min} are upper and lower limits of the variable and $\mathcal{R}$ is a random number from the sequence normalized so that

$$0 < \mathcal{R} < 1.$$

Normally distributed variables are constructed as

$$V = \left(\sum_{i=1}^{12} \mathcal{R}_i - 6\right)\sigma_v + V_o \; ; \quad V_o - 6\sigma_v \leq V \leq V_o + 6\sigma_y$$

where V_o is the mean value and $\mathcal{R}_i$ is a normalized random number.

Since for some values a point can be properly within the distribution and outside the limits of regions specified elsewhere, the distribution actually used for calculations is that determined by the intersection of the specified distribution and the specified geometric configuration. An example is the point x,y in a circle in which

$$x_{min} < x < x_{max} \qquad \text{and}$$

$$y_{min} < y < y_{max} \qquad \text{but}$$

$$\sqrt{(x-x_o)^2 + (y-y_o)^2} > \frac{x_{max} - x_{min}}{2}$$

For convenience in recreating any particular machine run and as a protection from bias due to using too small a subset of the random number sequence, the last random number of the sequence is printed with the usual output from each problem. If another problem is begun immediately, the printed number may be ignored. If this was the last problem of the set or if manual intervention of the calculations was necessary, there is provision for reading in this "starting value" for the random number generator as an input parameter.

Uses

The random variates, impact locations and personnel distribution can be varied and the output studied to establish confidence bounds on the frequency distributions, P_c and the moments and to determine the number of machine runs required to produce statistical stability.

Once confidence bounds are established, the model may be used to study the influence of the individual characteristics of a CW weapons system. Parameters may be varied either individually or in subsets and the output used in the design of more efficient CW weapons systems.

Both the Overlay Program and the Analytic Dissemination Program were written in SAP language. These were assembled into machine language by BSBELL SAP 3-7 assembly system.

Pertinent manuals:

Bell Telephone Laboratory	BESYS2 Manual
National Bureau of Standards	BSBEL Manual
United Airlines	SAP 3-7 Manual
(SHARE 716)	
IBM Reference Manual	A22-6500-3

Appendix IA

Description of the Overlay Program

The program computes the dose or dosage at all points on a target plane as a result of an arbitrary number of munitions which are distributed within a geometric configuration or impact area on the plane.

Each munition is assumed to produce a rectangular unit dissemination pattern symmetric about the mean wind direction. This pattern is called the unit dissemination grid or udg. The wind direction is assumed to be parallel to the x axis and in the direction of increasing x. The input section of the routine takes advantage of the symmetry by reading only the half pattern and reflecting all entries except those for the center line.

The impact area may be either a circle or a rectangle, and munitions may be distributed within this area either with a uniform random or an elliptical normal distribution or they may be read. All munition co-ordinates are rounded toward the center of the impact area to a grid point. A point lying on the boundary of the impact area is considered within the area.

The target plane is constructed as a function of the dimensions of the udg and the impact area to be the minimum rectangle circumscribing all grid points which could be affected by any munition arriving in the impact area. The length of the target area is that of the impact area plus that of the udg; the width, that of the impact area plus twice the half width of the udg rounded to the next highest even number of grid points.

The memory map technique is used for the overlay. Half words (18 bits) are used for each target area grid point, and whole words (36 bits) are used for each point of the udg. Munitions are generated or read and overlaid singly so that the memory storage required is independent of the number of munitions. The maximum size of a problem which may be run is dependent only on the dimensions of the two grids.

If M is the length of the impact area,
N is the width of the impact area,
m is the length of the udg,
n is the width of the udg,

Δm is the length mesh size, and

Δn is the width mesh size,

a problem which may be run must satisfy the inequalities:

$$\frac{m \cdot n + \frac{1}{2}(M + m)(N + n + 3)}{\Delta m \cdot \Delta n} < 27564 \quad \text{and}$$

$$\frac{N + n + 3}{\Delta n} \leq 200 \quad \text{(this must be satisfied only if the target map is to be printed.)}$$

Because of timing, this program should be used instead of the analytic dissemination function program described in Appendix II if the product of the number of points on the target times the number of munitions is large (more than 300,000) and the dimensions are such that the two inequalities are satisfied.

Although 18 bits are used to represent each grid point, only 17 are available for storage of dose, dosage, or concentration. The leading bit is always used to indicate whether the point is inside or outside the impact area. The maximum permissible value is therefore $2^{17} - 1$ or 131,071. The routine substitutes this maximum value for any value calculated which exceeds the maximum. The allowable non-zero range is all integers less than 131,072; since this is a rather limited range, there is provision in the routine for scaling the input udg for internal calculations and restoring the scaling to that of the input for output. This device does not increase the precision of the calculations but does permit all problems to use the same scaling for all udg's without avoidable loss of precision. All calculations except the moments are done in fixed point arithmetic; the moments and target area sums are printed in floating point form.

The routine will operate on any 32K IBM 704 with at least two magnetic tape units and an on-line printer.

I:

All data input is from magnetic tape although it could be from cards with a change of two instructions. All data is in a card length format to conform to the requirements of the SHARE input subroutine used. The subroutine requires that columns 1-7 and column 11 be blank and that columns 8-10 be DEC. Columns 12-72 contain the data, each field an integer less than or equal to eleven digits in length with fields separated by commas; there may be no data following a blank column on

the card since the input routine controls on a blank as the end of an input record. Columns 73-80 are not read by the 704 so are normally used for information to facilitate card manipulation either manually or with EAM equipment. If the data required for a single item exceeds the sixty-one columns available on a single card, the remaining information may be put on a trailer card with the same format. Restrictions for a trailer card are that a field must not be split between two cards, and that a comma not be used following the last data field on the leading card. Multiple trailer cards may be used in the same manner. Since all input field lengths are variable, any type of input card described may actually be a group of two or more cards. The flow chart indicates the organization of the routine but does not approach an instruction by instruction paraphrase of the routine.

Input Cards:

I. Card 1 is the identification card.

A. Field 1 is the udg identification number. It is not used by the routine except to print back for output identification.

B. Field 2 is the number of x mesh points in the udg or the number of cards in the udg input.

C. Field 3 is the number of y mesh points in the input (half) udg. Normally this is the number of fields on each of the udg cards, but it may be less than the number of fields if part of a larger udg is being used.

D. Field 4 is the x mesh size of the udg.

E. Field 5 is the y mesh size of the udg.

F. Field 6 is the scaling factor used for the udg. It is the power of two by which the doses, dosages, or concentrations will be divided for the internal calculations.

G. Field 7 is a dimension of the impact area; the radius, if the area is a circle; the x half length if the area is a rectangle. If negative, the absolute value is used as dimension and munitions are read.

H. Field 8 is zero if the impact area is a circle; the y half length if the area is a rectangle.

I. Field 9 is zero if the munition distribution is uniform, σ_x if distribution is normal.

J. Field 10 is zero if the munition distribution is unifrom, σ_y if distribution is normal.

K. Field 11 is the number of munitions; if negative, the absolute value is the number of munitions and the target map print is omitted.

L. Field 12 is the number of replications.

M. Field 13 is an exit parameter; zero if there is another problem to follow, one if this is the last problem.

N. Field 14 is the number of class intervals for output. It must be a multiple of 10, greater than zero and less than or equal to 100.

O. Field 15 is a random number starting value or zero. If zero, the existing random number (in computer memory) is not changed. If not zero, the field is used as a starting value. Normally the first problem of a set has a non zero value (from a previous run), and the remaining problems of the set have zeroes.

P. Field 16 is the number of probit classes or zero if probit output is not used.

II. Card 2 - These appear only if probit output is to be used. There are enough cards of this type to contain the number of fields specified in field 16 of card 1. These fields are doses which correspond to each of the probit classes in the same scaling as card 3's.

III. Card 3 - There are as many of these as are indicated in field 2 of card 1. Each card represents the udg half pattern for an x value implied by the index of the card. The first card is for $x=0$ and the remaining for successive integral multiples of Δx. The first entry on each card represents $y=0$, and each of the remaining represents points both positive and negative successive integral multiples of Δy.

IV. Card 4 - is used to check synchronization of dimensions of udg as specified by card 1 and as actually found by the routine in reading card 3's. It consists of ten fields of 99999.

V. Card 5 - These appear only if munitions are to be read rather than generated. Each munition is read from a single card containing an x and a y co-ordinate. For each replication as specified on the identification card there must be a 0,0 card following the munition cards. Munitions lying outside the impact area are rejected; the number of munitions specified is overridden by the number encountered which are within the impact area. The only external manifestation of inconsistency between expected and found munitions occurs in the dose or dosage sums print where the two dose or dosage sums will differ.

Output:

I. On line (printer) output consists only of operator instructions which should be self-explanatory and of a print back of card 1 for every problem plus a single line print for each replication consisting of: RUN aOFb where a is replication index and b is total number of replications. If the synchronization card does not check at the end of udg input, there is a print of PATTERN IS WRONG and run will not continue.

II. The off-line (magnetic tape) output is all on a single tape.

A. Card 1 is printed each time one is encountered as input preceded by the word INPUT.

B. There is an optional print of the dose or dosage map of the target area. This is controlled by the sign of field 11 of the identification card. The column vectors are printed by descending values of x from the maximum to zero. Within each column the entries are in order of descending y. With each column there is a print of the proper x value. To reduce printing volume the sign position of each element printed is used to indicate whether the point is inside or outside the impact area. A negative dose indicates that the point is inside the impact area.

C. A replication count is printed as RUN a OF b just as on line print where a is the replication index and b is the total number of replications.

D. The dose or dosage sum print consists of the following sums:

1. The udg sum with internal scaling as an integer.
2. The udg sum times the number of munitions with input-output scaling as a floating point number.
3. The target sum with input-output scaling as a floating point number.
4. (2) and (3) should be equal unless some point has accumulated more than the maximum permissible dose or dosage or munitions have been read and the number expected differed from the number found.
5. The format: DOSE SUMS (1) (2) (3)

E. Two sets of class interval counts are printed, perhaps separated by the probit output. The class intervals are determined by dividing the largest dose or dosage by the number of class intervals desired and constructing uniform increments equal to the quotient rounded to the next largest integer. The prints have identical format. In each case there is a one line print of class intervals, then a line with the count of grid points inside the impact area for each class interval; then the same counts for points outside the impact area. In both cases the counts are constructed by including in each interval all points which are greater than or equal to that interval but less than the next larger.

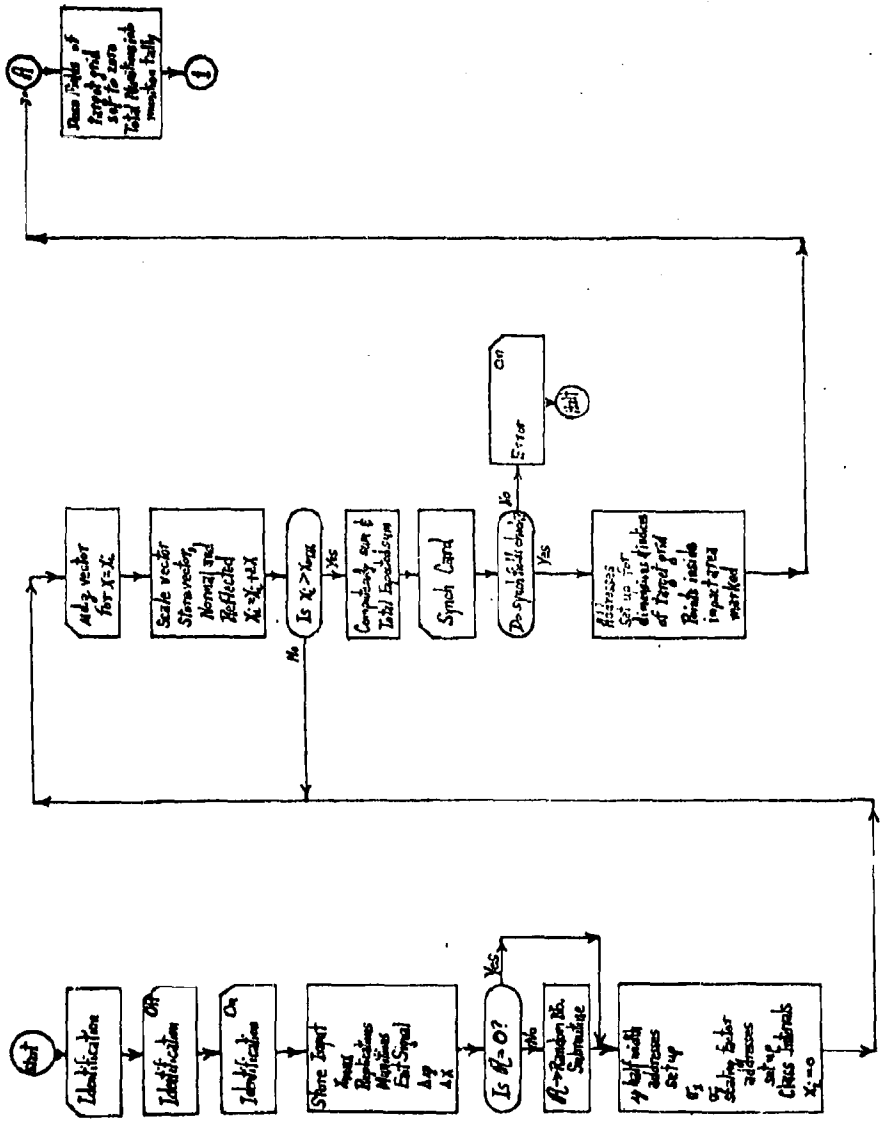
1. The first class interval print shows counts which are non-cumulative.
2. The probit output.
3. The second class interval print shows cumulative counts.

F. The first five moments are printed in floating point as: MOMENTS ARE M_1 M_2 M_3 M_4 M_5. If any moment is $> 10^{38}$, it cannot be calculated properly, and some incorrect non-predictable number will be printed instead.

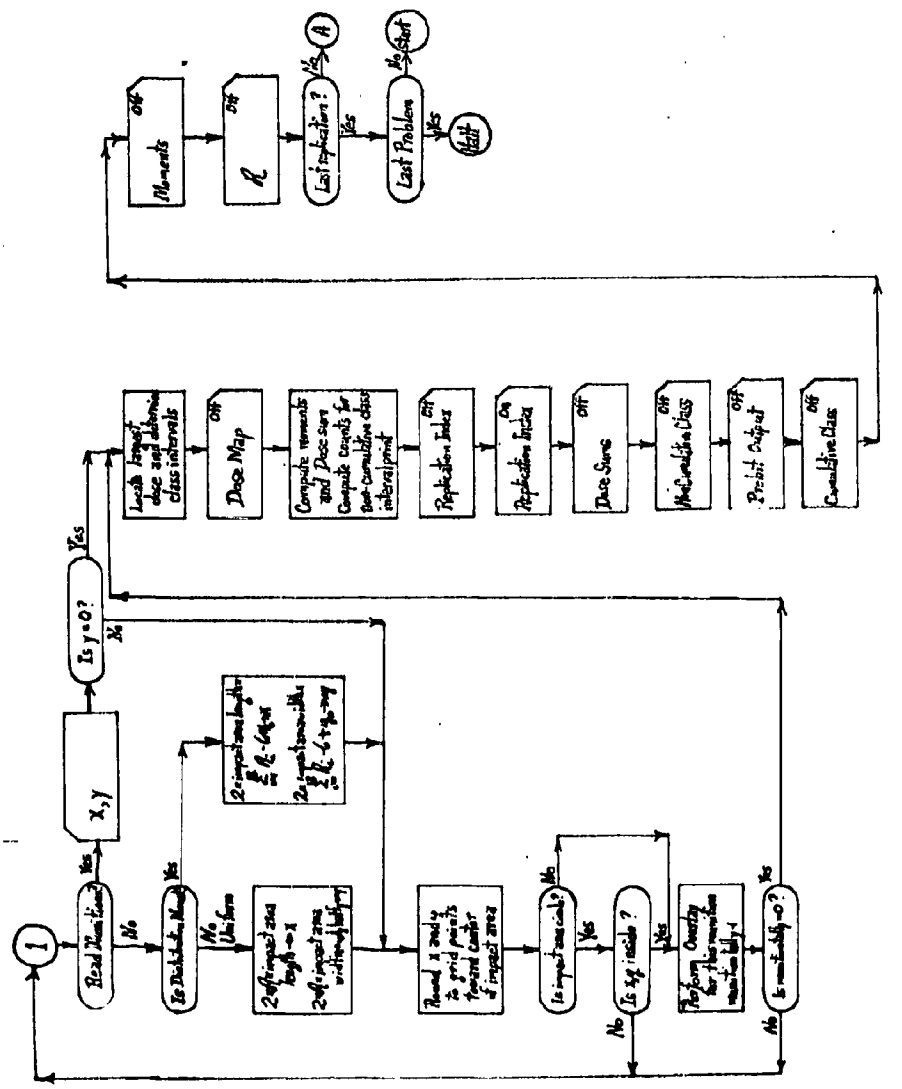
G. The random number starting value for the next problem is printed at the end of each problem. This may be used to start

the next machine run if a break in the machine sequence is necessary.

FLOW CHART FOR OVERLAY PROGRAM PAGE 1



FLOW CHART FOR OVERLAY PROGRAM PAGE 2



BESYS 2• SAP 3-7 ASSEMBLY OF OVERLAY PROGRAM PAGE 1

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      JOB 04500   HALL W CHEMICAL WARFARE GENERALIZED OVERLAY
PUNCH, SAP                                                                  45000002
      ORG 224                                                               04500010

                        00340          ORG 224                                        04500010
                        00030    OP    SYN 24                                         04500012
00340  0 07400 4 70010  BOXI1  TSX XINPUT,4                                          45000020
00341  0 00000 0 00000         0,0,0                                                 45000040

00342 -1 01774 0 01755         MON READ,0,READ+15                                     04500060
00343 -0 76000 0 00004         LFM                                                    45000070
00344  0 07400 4 70007         TSX OUTPUT,4                                           45000080
00345  0 00013 0 01671           ID,0,11                                              45000100
00346 -1 01774 0 01755         MON READ,0,READ+15                                     04500120
00347  0 07400 4 70007         TSX OUTPUT,4                                           45000140
00350  0 00011 0 01671           ID,0,9                                               45000160
00351 -1 01774 0 01755         MON READ,0,READ+15                                     04500180
00352 -0 50000 0 01756         CAL READ+1          PATTERN LENGTH                     45000200
00353  0 40200 0 02054         SUB IF                                                 45000220
00354  0 60100 0 02015         STO XMAX                                               45000240
00355  0 76700 0 00022         ALS 18                                                 45000260
00356  0 62200 0 00501         STD BOXR4                                              45000280
00357  0 50000 0 01770         CLA READ+11         REPLICATIONS                       45000300
00360  0 60100 0 02011         STO REP                                                45000320
00361  0 50000 0 01767         CLA READ+10                                            04500340
00362  0 60100 0 02051         STO OPOP                                               04500345
00363  0 76000 0 00003         SSP                                                    04500350
00364  0 60100 0 02040         STO MON                                                45000360
00365  0 50000 0 01771         CLA READ+12                                            45000380
00366  0 60100 0 02042         STO NSIG                                               45000400
00367  0 50000 0 01761         CLA READ+5          DELY                               45000440
00370  0 60100 0 02027         STO DELY                                               45000460
00371  0 50000 0 01760         CLA READ+3          DELX                               45000480
00372  0 60100 0 02026         STO DELX                                               45000500
00373  0 50000 0 01773         CLA READ+14                                            45000520
00374  0 10000 0 00376         TZE *+2                                                45000540
00375  0 60100 0 01663         STO ROW6+6                                             45000560
00376  0 50000 0 01774         CLA READ+15                                            04500564
00377  0 60100 0 02052         STO PROB                                               04500566
00400  0 10000 0 00404         TZE *+4                                                04500570
00401  0 07400 4 70010         TSX XINPUT,4                                           04500574
00402  0 00000 0 00000           0,0,0                                                04500578
00403 -1 02123 0 02101         MON PROT,0,PROT+18                                     04500576
00404  0 50000 0 01757         CLA READ+2                                             45000580
00405  0 60100 0 02037         STO YIP             Y HALF WIDTH                       45000600
00406  0 40100 0 00342         ADM BOXI1+2                                            45000620
00407  0 62100 0 00470         STA BOXR2                                              45000640
00410  0 40200 0 02054         SUB IF                                                 45000660
00411  0 76700 0 00022         ALS 18                                                 45000680
00412  0 62200 0 00456         STD BOXR1+3                                            45000700
00413  0 50000 0 02067         CLA LSAC                                               45000720
00414  0 40200 0 02037         SUB YIP                                                45000740
00415  0 62100 0 00472         STA BOXR2+2                                            45000760
00416  0 62100 0 00473         STA BOXR2+3                                            45000780
00417  0 50000 0 01764         CLA READ+7          ***                                45000800
00420  0 60100 0 02044         STO GS16            INPACT AREA CONFIGURATION          45000820
00421 -0 10000 0 00423         TNZ *+2                                                45000840
00422  0 50000 0 01763         CLA READ+6                                             45000860
00423  0 60200 0 02032         SLW RY                                                 04500865
00424  0 50000 0 01763         CLA READ+6                                             04500870
00425 -0 12000 0 01637         TMI ROMN                                               45000880
00426  0 56000 0 02077         LDQ NOP                                                04500865
00427 -0 60000 0 00732  ROW6   STO BOXG1                                              04500867
00430  0 60200 0 02031         SLW RX                                                 04500868
00431  0 50000 0 02037         CLA YIP                                                04500870
00432  0 40200 0 02054         SUB IF                                                 45000880
00433  0 40000 0 02037         ADD YIP                                                45000900
```

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```
00434  0 60100 0 02036        STO YT                                          45000920
00435  0 50000 0 01765        CLA READ+8                                      45000930
00436  0 60100 0 02043        STO SIGMA                                       45000940
00437  0 50000 0 01766        CLA READ+9                                      45000943
00440  0 60100 0 02046        STO SIGMAY                                      45000946
00441  0 50000 0 01762        CLA READ+5          SCALL FACTOR                45000950
00442  0 62100 0 00471        STA BOXR2+1         ***                         45000960
00443  0 62100 0 01227        STA BOXA6                                       45000962
00444  0 62100 0 01241        STA BOXA7                                       45000963
00445  0 62100 0 01177        STA BOXAA+2                                     45000964
00446  0 62100 0 01204        STA BOXAB+4                                     45000965
00447  0 62100 0 01147        STA BOXAN                                       45000966
00450  0 62100 0 00520        STA BOXT                                        45000967
00451  0 50000 0 01772        CLA READ+13                                     45000968
00452  0 60100 0 02045        STO NONTR                                       45000969
00453  0 53400 1 02053 BOXR1  LXA ZERO,1                                      45000970
00454  0 07400 4 70010        TSX XINPUT,4                                    45000980
00455  0 00000 0 00000          0,0,0                                         45000981
00456 -1 00000 0 01755        MON READ,0,**                                   45000982
00457  0 60000 0 01746        STZ COMMON                                      45000990
00460 -0 63400 1 01746        SXD COMMON,1                                    45001000
00461 -0 75400 0 00000        PXD                                             45001010
00462  0 56000 0 01746        LDQ COMMON                                      45001020
00463  0 76500 0 00022        LRS 18                                          45001030
00464  0 20000 0 02036        MPY YT                                          45001040
00465 -0 60000 0 01747        STQ COMMON+1                                    45001050
00466  0 53400 3 01747        LXA COMMON+1,3                                  45001060
00467  0 53400 4 02037        LXA YIP,4                                       45001070
00470  0 50000 4 00000 BOXR2  CLA **,4                                        45001080
00471  0 77100 0 00000        ARS **              SCALE INPUT                 45001090
00472  0 60100 2 00000        STO **,2            REFLECT                     45001100
00473  0 60100 1 00000        STO **,1                                        45001110
00474  1 77777 1 00475        TXI **+1,1,-1                                   45001120
00475  1 00001 2 00476        TXI **+1,2,1                                    45001130
00476  2 00001 4 00470        TIX BOXR2,4,1                                   45001140
00477 -0 53400 1 01746        LXD COMMON,1                                    45001150
00500  1 00001 1 00501        TXI **+1,1,1                                    45001160
00501 -3 00000 1 00454 BOXR4  TXL BOXR1+1,1,**                                45001170
00502  0 50000 0 02015        CLA XMAX                                        45001180
00503  0 40000 0 02054        ADD 1F                                          45001190
00504  0 76500 0 00043        LRS 35                                          45001200
00505  0 20000 0 02036        MPY YT                                          45001210
00506  0 76300 0 00043        LLS 35                                          45001220
00507  0 73400 4 00000        PAX 0,4                                         45001230
00510 -0 75400 0 00000        PXD                                             45001240
00511  0 40000 4 70000 BOXS   ADD 28672,4         SUM UNIT GRID               45001250
00512  2 00001 4 00511        TIX *-1,4,1                                     45001260
00513  0 60100 0 02001        STO USUM                                        45001270
00514  0 56000 0 02001        LDQ USUM                                        45001280
00515  0 20000 0 02040        MPY MUL                                         45001290
00516 -0 60000 0 02002        STQ MSUM            TOTAL DOSE                  45001300
00517  0 50000 0 02002        CLA MSUM                                        45001301
00520  0 76700 0 00000 BOXT   ALS **                                          45001302
00521 -0 50100 0 02071        ORA FL2                                         45001303
00522  0 30000 0 02053        FAD ZERO                                        45001304
00523  0 60100 0 02002        STO MSUM                                        45001306
00524  0 07400 4 70010        TSX XINPUT,4                                    45001310
00525  0 00000 0 00000          0,0,0                                         45001311
00526 -1 01766 0 01755        MON READ,0,READ+9                               45001314
00527  0 53400 4 02037        LXA YIP,4           CHECK FOR SYNCH             45001320
00530  0 50000 0 02065        CLA 1S                                          45001330
00531  0 40200 4 01757        SUB READ+10,4                                   45001340
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```
00532 -0 10000 0 01634          INZ ERROR                    TO ERROR          45001350
00533  2 00001 4 00530          TIX *-3,4,1                                    45001360
00534  0 56000 0 02021 BOXR5    LDQ RX                                         45001370
00535  0 20000 0 02021          MPY RX                                         45001380
00536 -0 60000 0 02033          STQ RSQ                                        45001390
00537  0 50000 0 02054          CLA 1F                                         45001400
00540  0 60100 0 02010          STO REPC                                       45001410
00541  0 50000 0 02031          CLA RX                                         45001420
00542  0 76700 0 00001          ALS 1                                          45001430
00543  0 60100 0 02034          STO DIA                  ***                   45001440
00544  0 50000 0 02032          CLA RY                                         45001442
00545  0 76700 0 00001          ALS 1                                          45001444
00546  0 60100 0 02035          STO DIAY                                       45001446
00547  0 50000 0 02037          CLA YIP                                        45001450
00550  0 40200 0 02054          SUB 1F                                         45001460
00551  0 76500 0 00043          LRS 35                                         45001470
00552  0 20000 0 02027          MPY DELY                                       45001480
00553 -0 60000 0 02017          STQ YMIN                                       45001500
00554  0 50000 0 02017          CLA YMIN                                       45001510
00555  0 40000 0 02032          ADD RY                                         45001520
00556  0 60100 0 02021          STO YO                   X,Y OF IMPACT CENTER  45001530
00557  0 50000 0 02031          CLA RX                                         45001540
00560  0 60100 0 02020          STO XO                                         45001550
00561  0 50000 0 02015          CLA XMAX                                       45001560
00562  0 40000 0 02054          ADD 1F                                         45001570
00563  0 60100 0 01746          STO COMMON                                     45001580
00564  0 56000 0 01746          LDQ COMMON                                     45001590
00565  0 20000 0 02036          MPY YT                                         45001600
00566  0 76300 0 00043          LLS 35                                         45001610
00567  0 60100 0 02016          STO MMAX                                       45001620
00570 -0 76000 0 00003          SSM                                            45001630
00571  0 40000 0 02067          ADD LSAD                                       45001640
00572  0 62100 0 00726          STA BOXZ1                                      45001650
00573  0 62100 0 01044          STA BOXDE                                      45001660
00574  0 62100 0 01054          STA BOXOX                                      45001670
00575  0 62100 0 01072          STA BOXOC                                      45001680
00576  0 62100 0 01131          STA BOXA1                                      45001690
00577  0 62100 0 01135          STA BOXA2                                      45001700
00600  0 62100 0 01223          STA BOXA4                                      45001710
00601  0 62100 0 00636          STA BXIOR                                      04501711
00602  0 62100 0 01324          STA BOXA8                                      45001720
00603  0 62100 0 01330          STA BOXA5-1                                    45001721
00604  0 62100 0 01175          STA BOXAA                                      45001722
00605  0 62100 0 00674          STA BXIO7                                      04501723
00606  0 62100 0 01337          STA BOXAE+1                                    04501724
00607 -0 75400 0 00000          PXD                                            45001730
00610  0 56000 0 02021          LDQ YO                                         45001740
00611  0 22100 0 02027          DVP DELY                                       45001750
00612 -0 60000 0 02050          STO Y                                          45001760
00613  0 50000 0 02050          CLA Y                                          45001770
00614  0 40000 0 02054          ADD 1F                                         45001780
00615  0 76700 0 00001          ALS 1                                          45001790
00616  0 60100 0 02013          STO YDIM                                       45001800
00617  0 50000 0 02020          CLA XO                                         45001810
00620  0 40000 0 02031          ADD RX                                         45001820
00621  0 76500 0 00043          LRS 35                                         45001830
00622  0 22100 0 02026          DVP DELX                                       45001840
00623 -0 60000 0 02047          STO X                                          45001850
00624  0 50000 0 02047          CLA X                                          45001860
00625  0 40000 0 02015          ADD XMAX                                       45001870
00626  0 40000 0 02054          ADD 1F                                         45001880
00627  0 60100 0 02012          STO XDIM                                       45001890
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00630  0 40000 0 02054        ADD  1F                    ***                  45001900
00631  0 76500 0 00043        LRS  35                                         45001905
00632  0 20000 0 02013        MPY  YDIM                                       45001910
00633  0 76500 0 00001        LRS  1                                          45001920
00634 -0 60000 0 02014        STQ  TDIM                                       45001930
00635  0 53400 4 02014        LXA  TDIM,4                                        1932
00636  0 60000 4 00000 BXIOR  STZ  **,4                                          1934
00637  2 00001 4 00636        TIX  *-1,4,1                                       1936
00640  0 53400 4 02054        LXA  1F,4                                       45001940
00641  0 60000 0 02022        STZ  XI                                         45001950
00642  0 60000 0 02023 BXIO3  STZ  YI                                         45001960
00643  0 76000 0 00140        SLF                                             45001970
00644  0 53400 2 02013        LXA  YDIM,2                                     45001980
00645  0 50000 0 02022        CLA  XI                                         45001990
00646  0 40200 0 02010        SUB  X0                                         45002000
00647  0 60100 0 01751        STO  COMMON+3              DELTA X              45002010
00650  0 50000 0 02044        CLA  GSIG                                       45002020
00651 -0 10000 0 01616        TNZ  BXREC                 RECTANGLE            45002030
00652  0 56000 0 01751        LDQ  COMMON+3                                   45002040
00653  0 20000 0 01751        MPY  COMMON+3                                   45002050
00654 -0 60000 0 01751        STQ  COMMON+3                                   45002060
00655  0 50000 0 02044 BXIO6  CLA  GSIG                                       04502060
00656 -0 10000 0 01616        TNZ  BXREC                                      04502063
00657  0 50000 0 02021        CLA  Y0                                         04502066
00660  0 40200 0 02023        SUB  YI                                         45002070
00661  0 60100 0 01752        STO  COMMON+4                                   45002080
00662  0 56000 0 01752        LDQ  COMMON+4                                   45002090
00663  0 20000 0 01752        MPY  COMMON+4                                   45002100
00664 -0 60000 0 01752        STQ  COMMON+4                                   45002110
00665  0 50000 0 01752        CLA  COMMON+4                                   45002120
00666  0 40000 0 01751        ADD  COMMON+3                                   45002130
00667  0 56000 0 02033        LDQ  KSW                                        45002140
00670  0 04000 0 00717        TLQ  BXIO8                                      45002150
00671 -0 50000 0 02072 BXIO2  CAL  RHI                                        45002160
00672 -0 76000 0 00141        SLT  1                                          45002170
00673 -0 50000 0 02073        CAL  LHI                                        45002180
00674 -0 60200 4 00000 BXIO7  ORS  **,4                                       04502190
00675  0 50000 0 02023        CLA  YI                                         45002200
00676  0 40000 0 02027        ADD  DELY                                       45002210
00677  0 60100 0 02023        STO  YI                                         45002220
00700  2 00001 2 00711        TIX  BXIO4,2,1                                  45002230
00701  0 50000 0 02022        CLA  XI                                         45002240
00702  0 40000 0 02026        ADD  DELX                                       45002250
00703  0 60100 0 02022        STO  XI                                         45002260
00704  1 00001 4 00705        TXI  *+1,4,1                                    45002270
00705  0 40200 0 02034 BXIOX  SUB  DIA                   ***                  45002280
00706  0 10000 0 00642        TZE  BXIO3                                      45002290
00707 -0 12000 0 00642        TMI  BXIO3                                      45002300
00710  0 02000 0 00723        TRA  BXIO9                                      45002310
00711 -0 76000 0 00142 BXIO4  SLT  2                                          45002320
00712  0 02000 0 00714        TRA  *+2                                        45002330
00713  1 00001 4 00655        TXI  BXIO6,4,1                                  45002340
00714  0 76000 0 00141        SLN  1                                          45002350
00715  0 76000 0 00142        SLN  2                                          45002360
00716  0 02000 0 00655        TRA  BXIO6                                      45002370
00717 -0 76000 0 00141 BXIO8  SLT  1                                          45002380
00720  0 76100 0 00000        NOP                                             45002390
00721 -0 75400 0 00000        PXD                                             45002400
00722  0 02000 0 00674        TRA  BXIO7                                      45002410
00723  0 76000 0 00140 BXIO9  SLT                                            45002420
00724  0 53400 4 02014        LXA  TDIM,4                                     45002430
00725 -0 50000 0 02074        CAL  SIGDT                                      45002440
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00726  0 32000 4 00000  BOXZ1  ANS  **,4                                    45002440
00727  2 00001 4 00726          TIX  *-1,4,1                                45002450
00730  0 53400 4 02040          LXA  MUN,4                                  45002460
00731 -0 63400 4 02041          SXD  MUNC,4                                 45002470
00732  0 02000 0 00000  BOXG1  TRA  **                                      45002480
00733  0 50000 0 02043          CLA  SIGMA                                  45002485
00734 -0 10000 0 01550          TNZ  NMN                NORMAL DISTIBUTION  45002490
00735  0 07400 4 01653          TSX  RDNO,4             UNIFORM             45002500
00736  0 20000 0 02034          MPY  DIA                                    45002510
00737  0 60100 0 02047          STO  X                                      45002520
00740  0 07400 4 01653          TSX  RDNO,4                                 45002530
00741  0 20000 0 02035          MPY  DIAY                                   45002540
00742  0 40000 0 02017          ADD  YMIN                                   45002550
00743  0 60100 0 02050          STO  Y                                      45002560
00744  0 50000 0 02054  BOXGR   CLA  IF                                     45002570
00745  0 60100 0 01746          STO  COMMON                                 45002580
00746  0 60100 0 01747          STO  COMMON+1                               45002590
00747  0 50000 0 02047          CLA  X                                      45002600
00750  0 40200 0 02020          SUB  X0                                     45002610
00751 -0 12000 0 01542          TMI  BOXGA              QUAD 1 OR 4         45002620
00752  0 60100 0 01750  BOXG3   STO  COMMON+2                               45002630
00753  0 56000 0 01750          LDQ  COMMON+2                               45002640
00754  0 20000 0 01750          MPY  COMMON+2                               45002650
00755 -0 60000 0 01750          STQ  COMMON+2                               45002660
00756  0 50000 0 02050          CLA  Y                                      45002670
00757  0 40200 0 02021          SUB  Y0                                     45002680
00760 -0 12000 0 01545          TMI  BOXGB              QUAD 3 OR 4         45002690
00761  0 60100 0 01751  BOXG5   STO  COMMON+3           ***                 45002700
00762  0 50000 0 02044          CLA  GSIG                                   45002702
00763 -0 10000 0 00773          TNZ  BOXGX                                  45002705
00764  0 56000 0 01751          LDQ  COMMON+3                               45002710
00765  0 20000 0 01751          MPY  COMMON+3                               45002720
00766 -0 60000 0 01751          STQ  COMMON+3                               45002730
00767  0 50000 0 01751          CLA  COMMON+3                               45002740
00770  0 40000 0 01750          ADD  COMMON+2                               45002750
00771  0 56000 0 02033          LDQ  R50                                    45002760
00772  0 04000 0 00732          TLQ  BOXG1              REJECT MUNITION     45002770
00773 -0 75400 0 00000  BOXGX   PXD                                         45002780
00774  0 56000 0 02047          LDQ  X                                      45002790
00775  0 22100 0 02026          DVP  DELX                                   45002800
00776 -0 60000 0 01750          STQ  COMMON+2                               45002810
00777  0 50000 0 01750          CLA  COMMON+2                               45002820
01000  0 40000 0 01746          ADD  COMMON             ROUND X             45002830
01001  0 60100 0 02024          STO  X00                                    45002840
01002  0 56000 0 02050          LDQ  Y                                      45002850
01003 -0 75400 0 00000          PXD                                         45002860
01004  0 22100 0 02027          DVP  DELY                                   45002870
01005 -0 60000 0 01750          STQ  COMMON+2                               45002880
01006  0 50000 0 01750          CLA  COMMON+2                               45002890
01007  0 40000 0 01747          ADD  COMMON+1           ROUND Y             45002900
01010  0 60100 0 02025          STO  Y00                                    45002910
01011  0 56000 0 02024          LDQ  X00                                    45002920
01012  0 20000 0 02013          MPY  YDIM                                   45002930
01013  0 76300 0 00043          LLS  35                                     45002940
01014  0 40200 0 02013          SUB  YDIM                                   45002950
01015  0 40000 0 02025          ADD  Y00                IMPACT X,Y INDICES  45002960
01016  0 60100 0 01747          STO  COMMON+1           ***                 45002970
01017  0 53400 1 02054          LXA  ZERO,1                                 45002980
01020  0 50000 0 02015          CLA  YMAX                                   45002990
01021  0 76700 0 00022          ALS  18                                     45003000
01022  0 07700 0 01535          TSX  BOXGB                                  45003010
01023  0 60000 0 01752          STZ  COMMON+4                               45003020
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01024   0 02000 0 01033          TRA BOX07                                          45003030
01025   0 56000 0 02055  BOX02  LDQ 2F                                             45003040
01026  -0 60000 0 01746          STO COMMON                                         45003050
01027   0 02000 0 00752          TRA BOX03                                          45003060
01030   0 56000 0 02055  BOX04  LDQ 2F                                             45003070
01031   0 60100 0 01747          STO COMMON+1                                       45003080
01032   0 02000 0 00761          TRA BOX05                                          45003090
01033   0 53400 2 02036  BOX07  LXA YT,2          BEGIN OVERLAY                   45003100
01034   0 50000 0 01747          CLA COMMON+1                                       45003110
01035   0 40200 0 02037          SUB YIP                                            45003120
01036   0 40000 0 02055          ADD 2F                                             45003130
01037   0 76500 0 00001          LRS 1                                              45003140
01040   0 73400 4 00000          PAX 0,4                                            45003150
01041   0 50000 0 02025          CLA YOO                                            45003160
01042   0 76000 0 00001          LBT                                                45003170
01043   0 76000 0 00141          SLN 1              ODD STARTING PT (LEFT HALF)     45003180
01044  -0 50000 4 00000  BOX06  CAL **,4                                           45003190
01045  -0 32000 0 02075          ANA SIGCM                                          45003200
01046   0 76500 0 00022          LRS 18                                             45003210
01047   0 60100 0 01750          STO COMMON+2       LEFT                            45003220
01050  -0 75400 0 00000          PXD                                                45003230
01051   0 76300 0 00022          LLS 18                                             45003240
01052   0 60100 0 01751          STO COMMON+3       RIGHT                           45003250
01053  -0 50000 0 02074          CAL SIGBT                                          45003260
01054  -0 32000 4 00000  BOX0X  ANA **,4                                           45003270
01055   0 60200 0 01753          SLW COMMON+5                                       45003280
01056   0 50000 1 67777          CLA 28671,1                                        45003290
01057  -0 76000 0 00141          SLT 1                                              45003300
01060   0 02000 0 01113          TRA BOX01                                          45003310
01061   0 50000 1 67777  BOX02  CLA 28671,1          LEFT                            45003320
01062   0 40000 0 01751          ADD COMMON+3                                       45003330
01063   0 56000 0 02076          LDQ MASK                                           45003340
01064   0 04000 0 01124          TLQ BOX08                                          45003350
01065   0 60100 0 01751  BOX04  STO COMMON+3                                       45003360
01066   0 50000 0 01750          CLA COMMON+2                                       45003370
01067   0 76700 0 00022          ALS 18                                             45003380
01070  -0 50100 0 01751          ORA COMMON+3                                       45003390
01071  -0 60100 0 01753          ORA COMMON+5                                       45003400
01072   0 60200 4 00000  BOX0C  SLW **,4                                           45003420
01073   1 00001 1 01074          TXI **+1,1,1                                       45003430
01074   1 00001 4 01075          TXI **+1,4,1                                       45003440
01075   2 00001 2 01044          TIX BOX06,2,1                                      45003450
01076   0 50000 0 01747          CLA COMMON+1                                       45003460
01077   0 40000 0 02013          ADD YDIM                                           45003470
01100   0 60100 0 01747          STO COMMON+1                                       45003480
01101   0 50000 0 01752          CLA COMMON+4                                       45003490
01102   0 40000 0 02054          ADD 1F                                             45003500
01103   0 60100 0 01752          STO COMMON+4                                       45003510
01104   0 73400 4 00000          PAX 0,4                                            45003520
01105  -0 00000 4 01033  BOX08  TXL BOX07,4,**                                     45003530
01106  -0 53400 4 02041          LXD RUNC,4                                         45003540
01107   2 00001 4 01111          TIX BOX09,4,1                                      45003550
01110   0 02000 0 01126          TRA OUT                                            45003560
01111  -0 63400 4 02041  BOX0Y  SXD RUNC,4                                         45003570
01112   0 02000 0 00732          TRA BOX01                                          45003580
01113   0 40000 0 01750  BOX01  ADD COMMON+2                                       45003590
01114   0 56000 0 02076          LDQ MASK                                           45003600
01115   0 04000 0 01122          TLQ BOX0A                                          45003610
01116   0 60100 0 01750  BOX03  STO COMMON+2                                       45003620
01117   2 00001 2 01121          TIX **+2,2,1                                       45003630
01120   0 02000 0 01066          TRA BOX04+1                                        45003640
01121   1 00001 1 01061          TXI BOX02+1,1,1                                    45003650
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01122  0 50000 0 02076  BOXOA CLA MASK                                  45003660
01123  0 02000 0 01116        TRA BOX03                                  45003670
01124  0 50000 0 02076  BOXOB CLA MASK                                  45003680
01125  0 02000 0 01065        TRA BOX04                                  45003690
01126  0 53400 0 02014   OUT  LXA TDIM,3                                45003700
01127  0 56000 0 02053        LDQ ZERO                                   45003710
01130  0 50000 0 02076        CLA MASK                                   45003720
01131 -0 32000 1 00000  BOXA1 ANA **,1                                  45003730
01132  0 04000 0 01630        TLQ BOX61                                  45003740
01133  2 00001 1 01130        TIX *-3,1,1                                45003750
01134  0 76300 0 00022        LLS 18                                     45003760
01135  0 50000 2 00000  BOXA2 CLA **,2          ***                      45003770
01136  0 76000 0 00003        SSP                                        45003775
01137  0 04000 0 01632        TLQ BOX62                                  45003780
01140  2 00001 2 01135        TIX *-3,2,1                                45003790
01141 -0 75400 0 00000        PXD                                        45003800
01142  0 76500 0 00022        LRS 18                                     45003810
01143  0 22100 0 02045        DVP NONTR                                  45003820
01144 -0 60000 0 01746        STQ COMMON                                 45003830
01145  0 50000 0 01746        CLA COMMON                                 45003850
01146  0 40000 0 02054        ADD 1F                                     04503855
01147  0 76700 0 00000  BOXAN ALS **                                    04503860
01150  0 60100 0 02030        STO DELX                                   45003890
01151  0 53400 1 02014        LXA TDIM,1                                 45003900
01152  0 60000 0 02003        STZ M1                                     45003910
01153  0 60000 0 02004        STZ M2                                     45003920
01154  0 60000 0 02005        STZ M3                                     45003930
01155 -0 60000 0 02006        STZ M4                                     45003940
01156  0 60000 0 02007        STZ M5                                     45003950
01157 -0 50000 0 01215        CAL BOXAD                                  45003970
01160  0 40000 0 02013        ADD YDIM                                   45003980
01161  0 62100 0 01205        STA BOXAC                                  04503990
01162  0 40000 0 02054        ADD 1F                                     04503995
01163  0 62100 0 01200        STA BOXAB                                  04504000
01164  0 40200 0 02055        SUB 2F                                     04504010
01165  0 76700 0 00022        ALS 18                                     45004020
01166  0 62200 0 01215        STO BOXAD                                  45004030
01167  0 56000 0 02017        LDQ XDIM                                   04504040
01170  0 20000 0 02026        MPY DELX                                   04504045
01171 -0 60000 0 02042        STQ XI                                     04504050
01172  0 50300 0 02051        CLA OPOP                                   04504055
01173 -0 12000 0 01222        TMI BOXA4-1                                04504056
01174  0 53400 2 02013        LXA YDIM,2                                 45004060
01175  0 50000 1 00000  BOXAA CLA **,1                                  45004070
01176  0 76500 0 00022        LRS 18                                     45004080
01177  0 76700 0 00000        ALS **                                     45004090
01200  0 60100 2 00030  BOXAB STO OP***,2                               45004100
01201 -0 77300 0 00001        RQL 1                                      45004110
01202 -0 75400 0 00000        PXD                                        45004120
01203  0 76300 0 00021        LLS 17                                     45004130
01204  0 76700 0 00000        ALS **                                     45004140
01205  0 60100 2 00030  BOXAC STO OP***,2                               45004160
01206  1 77777 1 01207        TX1 *+1,1,-1                               45004170
01207  2 00002 2 01175        TIX BOXAA,2,2                              04504180
01210  0 07400 4 70007        TSX OUTPUT,4                               45004190
01211  0 00011 0 01675              XPRT,0,9                             45004201
01212 -1 02022 0 02022        ADD XI,0,XI                                45004210
01213  0 07400 4 70007        TSX OUTPUT,4                               45004220
01214  0 00011 0 01677              YPRT,0,9                             45004230
01215 -1 00030 0 00030  BOXAD ADD OP**,OP***                             45004240
01216  0 50000 0 02042        CLA XI                                     45004250
01217  0 40200 0 02076        SUB DELX                                   45004260
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```
01220   0 60100 0 02022          STO X1                                  04504265
01221   3.00000 1 01174          TXH BOXAA-1,1,0                         04504270
01222   0 53400 1 02014          LXA TDIM,1                              04504275
01223  -0 50000 1 00000  BOXA4   CAL **,1                                4500428C
01224  -0 32000 0 02075          ANA SIGCM                               45004290
01225   0 10000 0 01331          TZE BOXA5                                  4300
01226  .0 76500 0 00022          LRS 18                                  45004310
01227   0 76700 0 00000  BOXA6   ALS **                                     4312
01230   0 60100 0 01751          STO COMMON+3                            45004315
01231  -0 60000 0 01747          STO COMMON+1                               4316
01232   0 10000 0 01235          TZE *+3                                 45004320
01233  -0 50100 0 02071          ORA FLZ                                 45004330
01234   0 30000 0 02053          FAD ZERO                                04504335
01235   0 60100 0 01746          STO COMMON                              45004340
01236   0 56000 0 01747          LDQ COMMON+1                               4345
01237  -0 75400 0 00000          PXD                                     45004350
01240   0 76300 0 00022          LLS 18                                  45004360
01241   0 76700 0 00000  BOXA7   ALS **                                     4362
01242   0 60100 0 01752          STO COMMON+4                            45004365
01243   0 10000 0 01246          TZE *+3                                 45004370
01244  -0 50100 0 02071          ORA FLZ                                 45004380
01245   0 30000 0 02053          FAD ZERO                                04504385
01246   0 60100 0 01747          STO COMMON+1                            45004400
01247   0 76000 0 00140          SLF                                     45004410
01250   0 56000 0 01746  BOXA9   CLA COMMON                              45004420
01251   0 10000 0 01307          TZE BOXA3                               45004430
01252   0 30000 0 02003          FAD M1                                  45004440
01253   0 60100 0 02003          STO M1                                  45004450
01254   0 56000 0 01746          LDQ COMMON                              45004460
01255   0 26000 0 01746          FMP COMMON                              45004470
01256   0 60100 0 01750          STO COMMON+2                            45004480
01257   0 30000 0 02004          FAD M2                                  45004490
01260   0 60100 0 02004          STO M2                                  45004500
01261   0 56000 0 01746          LDQ COMMON                              45004510
01262   0 26000 0 01750          FMP COMMON+2                            45004520
01263   0 60100 0 01750          STO COMMON+2                            45004530
01264   0 30000 0 02005          FAD M3                                  45004540
01265   0 60100 0 02005          STO M3                                  45004550
01266   0 56000 0 01746          LDQ COMMON                              45004560
01267   0 26000 0 01750          FMP COMMON+2                            45004570
01270   0 60100 0 01750          STO COMMON+2                            45004580
01271   0 30000 0 02006          FAD M4                                  45004590
01272   0 60100 0 02006          STO M4                                  45004600
01273   0 56000 0 01746          LDQ COMMON                              45004610
01274   0 26000 0 01750          FMP COMMON+2                            45004620
01275   0 30000 0 02007          FAD M5                                  45004630
01276   0 60100 0 02007          STO M5                                  45004640
01277  -0 75400 0 00000          PXD                                     45004650
01300   0 56000 0 01751          LDQ COMMON+3                            45004660
01301   0 22100 0 02050          DVP DEL                                 45004670
01302  -0 60000 0 01751          STO COMMON+3                            45004680
01303   0 50000 0 01751          CLA COMMON+3                            45004690
01304   0 76000 0 00006          COM                                     45004700
01305   0 40000 0 02054          ADD 1F                                  45004710
01306  -0 32000 0 02076          ANA MASK                                04504725
01307  -0 76000 0 00141  BOXA3   SLT 1                                   45004730
01310   0 02000 0 01312          TRA *+2                                 45004740
01311   0 02000 0 01322          TRA BOXAB-1                             45004750
01312   0 76000 0 00141          SLT 1                                   45004760
01313   0 56000 0 02051          LDQ ZERO                                   4765
01314   0 76500 0 00021          LRS 17                                  04504770
01315  -0 60000 0 01753          STO COMMON+5                            45004780
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01316  0 50000 0 01747        CLA COMMON+1                                    45004790
01317  0 60100 0 01746        STO COMMON                                      45004800
01320  0 50000 0 01752        CLA COMMON+4                                    45004810
01321  0 60100 0 01751        STO COMMON+3                                    45004820
01322  0 02000 0 01250        TRA BOXA9                                       45004830
01323  0 60100 0 01751        STO COMMON+3                                    45004840
01324 -0 50000 1 00000 BOXA8  CAL **,1                                        45004850
01325 -0 32000 0 02074        ANA SIGBT                                       45004860
01326 -0 50100 0 01751        ORA COMMON+3                                    45004870
01327 -0 50100 0 01753        ORA COMMON+5                                    45004880
01330  0 60200 1 00000        SLW **,1                                        45004890
01331  2 00001 1 01223 BOXA5  TIX BOXA4,1,1                                      4900
01332  0 53400 1 02063        LXA 200F,1                                      45004910
01333  0 60000 1 00340        STZ OP+200,1                                    45004920
01334  2 00001 1 01333        TIX *-1,1,1                                     45004930
01335  0 53400 2 02014        LXA TRIM,2                                      45004940
01336  0 76000 0 00140 BOXAE  SLF                                            45004950
01337  0 50000 2 00000        CLA **,2                                        04504960
01340  0 73400 4 00000        PAX 0,4                                         45004970
01341 -0 73400 1 00000        PDX 0,1                                         45004980
01342 -0 12000 0 01344        TMI *+2                                         45004990
01343  0 76000 0 00141        SLN 1                          OUTSIDE          45005000
01344  0 76500 0 00021        LRS 17                                          45005010
01345  0 76000 0 00001        LBT                                             45005020
01346  0 02000 0 01532        TRA BOXAF                      OUT              45005030
01347  0 50000 0 02054        CLA 1F                         IN               45005040
01350  0 40000 4 00030        ADD OP,4                                        04505050
01351  0 60100 4 00030        STO OP,4                                        04505060
01352 -0 76000 0 00141 BOXAH  SLT 1                                           45005070
01353  0 02000 0 01536        TRA BOXAG                                       45005080
01354  0 50000 0 02054        CLA 1F                                          45005090
01355  0 40000 1 00174        ADD OP+100,1                                    04505100
01356  0 60100 1 00174        STO OP+100,1                                    04505110
01357  2 00001 2 01336        TIX BOXAL,2,1                                   45005120
01360  0 76000 0 00140        SLF                                             45005125
01361  0 07400 4 70007        TSX OUTPUT,4                                    04505126
01362  0 00011 0 01712            RPPR,0,9                                    04505127
01363 -1 02011 0 02010        MON REPC,0,REP                                  04505128
01364  0 07400 4 70007        TSX OUTPUT,4                                    04505129
01365  0 00011 0 01723            ORPPR,0,11                                  04505130
01366 -1 02011 0 02010        MON REPC,0,REP                                  04505131
01367  0 07400 4 70007        TSX OUTPUT,4                                    04505132
01370  0 00011 0 01731            DOSE,0,9                                    04505133
01371 -1 02003 0 02001        MON USUM,0,M1                                   04505134
01372  0 50000 0 01715 BOXAK  CLA PI                                          04505135
01373  0 60100 0 01412        STO BOXA1                                       45005140
01374  0 50000 0 01716        CLA PO                                          45005150
01375  0 60100 0 01415        STO BOXA1+3                                     45005160
01376  0 60000 0 01755        STZ READ                                        45005170
01377  0 53400 1 02045        LXA NONTR,1                                        5180
01400  0 53400 2 02057        LXA 10F,2                                       45005190
01401  0 50000 2 01767 BOXAJ  CLA RLAD+10,2                                   45005200
01402  0 40000 0 02030        ADD DEL                                         45005210
01403  0 60100 2 01770        STO READ+11,2                                   45005220
01404  2 00001 2 01402        TIX *-2,2,1                                     45005230
01405  0 07400 4 70007        TSX OUTPUT,4                                    45005240
01406  0 00011 0 01701            INTR,0,9                                    45005250
01407 -1 01766 0 01755        MON READ,0,RLAD+9                               45005260
01410  0 07400 4 70007        TSX OUTPUT,4                                    45005270
01411  0 00011 0 01704            INPRT,0,9                                   45005280
01412 -1 00011 0 00000 BOXAI  MON **,0,**+9                                   45005290
01413  0 07400 4 70007        TSX OUTPUT,4                                    45005300
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01414  0 00011 0 01707          OUTPR,0,9                                  45005310
01415 -1 00155 0 00144       MON ***100,0,***109                            45005320
01416  0 50000 0 01412          CLA BOXAI                                  45005330
01417  0 40200 0 02070          SUB MOD                                    45005340
01420  0 60100 0 01412          STO BOXAI                                  45005350
01421  0 50000 0 01415          CLA BOXAI+3                                45005360
01422  0 40200 0 02070          SUB MOD                                    45005370
01423  0 60100 0 01415          STO BOXAI+3                                45005380
01424  0 50000 0 01767          CLA READ+10                                45005390
01425  0 60100 0 01755          STO READ                                   45005400
01426  2 00012 1 01400          TIX BOXAJ-1,1,10                           04505410
01427 -0 76000 0 00141          SLT 1                                      45005420
01430  0 02000 0 01432          TRA *+2                                    45005430
01431  0 02000 0 01501          TRA BOXAM                                  45005440
01432  0 50000 0 02052          CLA PROB                                   04505441
01433  0 10000 0 01465          TZE DACC                                   04505442
01434  0 53400 1 02066          LXA 20F,1                                  04505443
01435  0 60000 1 02001          STZ READ+20,1          CLEAR OUTPUT        04505444
01436  2 00001 1 01435          TIX *-1,1,1                                04505445
01437  0 50000 0 00030          CLA OP                                     04505446
01440  0 40000 0 00174          ADD OP+100                                 04505447
01441  0 60100 0 01755          STO READ                                   04505448
01442  0 53400 1 02061          LXA 99F,1              CLASS INDEX         04505449
01443  0 53400 2 02053          LXA ZERO,2             PROBIT INDEX        04505450
01444  0 50000 0 02030          CLA DEL                                    04505451
01445  0 77100 0 00001          ARS 1                                      04505452
01446  0 40000 0 02030          ADD DEL                                    04505453
01447  0 60100 0 02047  Q       STO X                                      04505454
01450  0 34000 2 02101          CAS PROT,2                                 04505455
01451  1 77777 2 01450          TXI *-1,2,-1           TABLE LESS          04505456
01452  0 76100 0 00000          NOP                                        04505457
01453  0 50000 2 01756          CLA READ+1,2           X LESS              04505458
01454  0 40000 1 00174          ADD OP+100,1                               04505459
01455  0 40000 1 00340          ADD OP+200,1                               04505460
01456  0 60100 2 01756          STO READ+1,2                               04505461
01457  0 50000 0 02047          CLA X                                      04505462
01460  0 40000 0 02030          ADD DEL                                    04505463
01461  2 00001 1 01447          TIX Q,1,1                                  04505464
01462  0 07400 4 70007          LSX OUTPUT,4                               04505465
01463  0 00011 0 01742              PROBIT,0,9                             04505466
01464 -1 02000 0 01755       MON READ,0,READ+19                             04505467
01465  0 76000 0 00141  DACC   SLN 1                                       04505468
01466  0 53400 1 02061          LXA 99F,1                                  04505469
01467  0 53400 2 02053          LXA ZERO,2                                 45005470
01470  0 50000 2 00173  BOXAL  CLA OP+99,2                                 45005480
01471  0 40000 2 00172          ADD OP+98,2                                45005490
01472  0 60100 2 00172          STO OP+98,2                                45005500
01473  0 50000 2 00337          CLA OP+199,2                               45005510
01474  0 40000 2 00336          ADD OP+198,2                               45005520
01475  0 60100 2 00336          STO OP+198,2                               45005530
01476  1 00001 2 01477          TXI *+1,2,1                                45005540
01477  2 00001 1 01470          TIX BOXAL,1,1                              45005550
01500  0 02000 0 01372          TRA BOXAK                                  45005560
01501  0 50000 0 02014  BOXAM  CLA TOTM                                    45005570
01502  0 76700 0 00001          ALS 1                                      45005580
01503 -0 50100 0 02071          ORA FLZ                                    45005590
01504  0 30000 0 02053          FAD ZERO                                   45005600
01505  0 60100 0 01746          STO COMMON                                 45005610
01506  0 53400 1 02056          LXA 5F,1                                   45005620
01507  0 50000 1 02010          CLA M1+5,1                                 45005630
01510  0 26100 0 01746          FDP COMMON                                 45005640
01511 -0 60000 1 02010          STO M1+5,1                                 45005650
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01512  2 00001 1 01507        TIX *-3,1,1                              45005660
01513  0 07400 4 70007        TSX OUTPUT,4                             45005670
01514  0 00011 0 01717        MOM,0,9                                  45005680
01515 -1 02007 0 02003        MON M1,0,N5                              45005690
01516  0 07400 4 70007        TSX OUTPUT,4                             45005695
01517  0 00011 0 01736        RDP,0,9                                  45005696
01520 -1 01663 0 01663        MON RDNO+8,0,RDNO+8                      04505697
01521  0 50000 0 02011        CLA REP                                  45005700
01522  0 40200 0 02010        SUB REPC                                 45005710
01523  0 10000 0 01530        TZE END                                  45005720
01524  0 50000 0 02010        CLA REPC                                 45005730
01525  0 40000 0 02054        ADD 1F                                   45005740
01526  0 60100 0 02010        STO REPC                                 45005750
01527  0 02000 0 00723        TRA BXI09                                45005760
01530  0 10000 0 00340  END   TZE BOX11                                45005770
01531  0 07400 4 70022        TSX RETURN,4                             45005780
01532  0 50000 0 02054  BOXAF CLA 1F                                   45005790
01533  0 40000 4 00174        ADD OP+100,4                             04505800
01534  0 60100 4 00174        STO OP+100,4                             04505810
01535  0 02000 0 01352        TRA BOXAH                                45005820
01536  0 50000 0 02054  BOXAG CLA 1F                                   45005830
01537  0 40000 1 00030        ADD OP,1                                 04505840
01540  0 60100 1 00030        STO OP,1                                 04505850
01541  0 02000 0 01357        TRA BOXAH+5                              45005860
01542  0 56000 0 02055  BOXGA LDQ 2F                                   45005870
01543 -0 60000 0 01746        STQ COMMON                               45005880
01544  0 02000 0 00752        TRA BOXG3                                45005890
01545  0 56000 0 02055  BOXGB LDQ 2F                                   45005900
01546 -0 60000 0 01747        STQ COMMON+1                             45005910
01547  0 02000 0 00761        TRA BOXG5                                45005920
01550  0 53400 1 02060    NMN LXA 12F,1                               45005930
01551  0 60000 0 02047        STZ X                                    45005940
01552  0 60000 0 02050        STZ Y                                    45005950
01553  0 07400 4 01653        TSX RDNO,4                               45005960
01554 -0 75400 0 00000        PXD                                      45005970
01555  0 76300 0 00022        LLS 18                                   45005980
01556  0 40000 0 02047        ADD X                                    45005990
01557  0 60100 0 02047        STO X                                    45006000
01560  0 07400 4 01653        TSX RDNO,4                               45006010
01561 -0 75400 0 00000        PXD                                      45006020
01562  0 76300 0 00022        LLS 18                                   45006030
01563  0 40000 0 02050        ADD Y                                    45006040
01564  0 60100 0 02050        STO Y                                    45006050
01565  2 00001 1 01553        TIX NMN+3,1,1                            45006060
01566  0 40200 0 02064        SUB 6C                                   45006070
01567  0 76500 0 00037        LRS 31                                   45006080
01570  0 20000 0 02046        MPY SIGMAY                               45006090
01571  0 76300 0 00015        LLS 13                                   04506100
01572  0 60100 0 01746        STO COMMON                                  6101
01573  0 76000 0 00003        SSP                                         6102
01574  0 40200 0 02032        SUB RY                                      6103
01575  0 10000 0 01577        TZE *+2                                     6104
01576  0 12000 0 00732        TPL BOXG1                                   6105
01577  0 50000 0 01746        CLA COMMON                                  6106
01600  0 40000 0 02021        ADD YO                                      6107
01601  0 60100 0 02050        STO Y                                    04506110
01602  0 50000 0 02047        CLA X                                    45006120
01603  0 40200 0 02064        SUB 6C                                   45006130
01604  0 76500 0 00037        LRS 31                                   45006140
01605  0 20000 0 02043        MPY SIGMA                                45006150
01606  0 76300 0 00015        LLS 13                                   04506160
01607  0 40000 0 02020        ADD XO                                   04506165
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01610  0 60100 0 02047        STQ X                                          04506170
01611 -0 12000 0 00732        TMI BOXG1                                          6174
01612  0 40200 0 02034        SUB DIA                                            6178
01613  0 10000 0 01615        TZE *+2                                            6180
01614  0 12000 0 00732        TPL BOXG1                                          6185
01615  0 02000 0 00744        TRA BOXGR                                      04506190
01616  0 50000 0 02031 BXREC  CLA RX                                         45006200
01617  0 40200 0 01751        SUB COMMON+3                                   45006210
01620  0 12000 0 01622        TPL *+2              POSSIBLY INSIDE           45006220
01621  0 02000 0 00717        TRA BXIO8                                      45006230
01622  0 50000 0 02023        CLA YI                                         45006240
01623  0 40200 0 02021        SUB YO                                         45006250
01624  0 76000 0 00003        SSP                                            04506255
01625  0 56000 0 02032        LDQ RY                                         45006260
01626  0 04000 0 00717        TLQ BXIO8            OUTSIDE                   45006270
01627  0 02000 0 00671        TRA BXIO2            INSIDE                    45006280
01630  0 76500 0 00043 BOXB1  LRS 35                                         45006290
01631  0 02000 0 01133        TRA BOXA1+2                                    45006300
01632  0 76500 0 00043 BOXB2  LRS 35                                         45006310
01633  0 02000 0 01140        TRA BOXA2+3                                    45006320
01634  0 07400 4 70013 ERROR  TSX XPRINT,4                                   45006330
01635 -1 01731 0 01726        MON LRP,0,ERP+3                                45006340
01636  0 07400 4 70024        TSX ENDJOB,4                                   45006350
01637  0 56000 0 02100 RDMN   LDQ TRA                                        04506360
01640  0 76000 0 00003        SSP                                            04506370
01641  0 02000 0 00427        TRA ROG                                        04506380
01642 -0 53400 4 02041 RDMUN  LXD MUNC,4                                     04506390
01643  1 00001 4 01644        TXI *+1,4,1                                    04506400
01644 -0 63400 4 02041        SXD MUNC,4                                     04506401
01645  0 07400 4 70010        TSX XINPUT,4                                   04506410
01646  0 00000 0 00000                0,0,0                                  04506411
01647 -1 02050 0 02047        MON X,0,Y                                      04506412
01650  0 50000 0 02050        CLA Y                                          04506420
01651  0 10000 0 01126        TZE OUT                                        04506430
01652  0 02000 0 00744        TRA BOXGR                                      04506440
01653  0 56000 0 01663 RDNO   LDQ RDNO+8           RANDOM                    45007000
01654  0 20000 0 01664        MPY RDNO+9           NUMBER                    45007001
01655 -0 60000 0 01663        STQ RDNO+8           SUBROUTINE                45007002
01656 -0 50000 0 01662        CAL RDNO+7                                     45007003
01657  0 76300 0 00033        LLS 27                                         45007004
01660  0 76100 0 00000        NOP                                            45007005
01661  0 02000 0 01666        TRA RDNO+11                                    45007006
01662 +000000000200           OCT 000000000200                               45007007
01663 +343277244615           OCT 343277244615                               45007008
01664 +343277244615           OCT 343277244615                               45007009
01665 +200000000000           OCT 200000000000                               45007010
01666  0 56000 0 02053        LDQ ZERO                                       45007011
01667  0 76300 0 00032        LRS 26                                         45007012
01670  0 02000 4 00001        TRA 1,4                                        45007013
01671  740630013145    ID     BCD 4(0H11INPUT14NO,N14,6C)                    04506000
01672  476463010445
01673  067345010473
01674  450634606060
01675  740330006,13    XPRT   BCD 2(3HOX=N8)                                45008001
01676  451034606060
01677  740330600100    YPRT   BCD 2(1H 10N11)                               45008002
01700  450101346060
01701  741030002343    INTR   BCD 3(8HOUTSIDE  10N11)                       45008003
01702  216262606001
01703  004501013460
01704  741030603145    INPRT  BCD 3(8H INSIDE  10N11)                       45008004
01705  623162756001
```

```
01706  004501013460
01707  741030604664      OUTPR BCD 3(8H OUTSIDLION11)                     45008005
01710  630231242501
01711  004501013460
01712  740430015164       RPPR BCD 3(4H1RUNN3,3H OFN3)                    04508006
01713  454503730330
01714  604626450334
01715 -1 00041 0 00030       PI MON OP,0,OP+9                             45008007
01716 -1 00205 0 00174       PO MON OP+100,0,OP+109                       45008008
01717  740102300044        MOM BCD 4(12HOMOMENTS ARE5E20.8)               45008009
01720  464425456362
01721  602151250525
01722  020033103460
01723  740430605164      ORPPR BCD 3(4H RUNN3,3H OFN3)                    04508010
01724  454503730310
01725  604626456334
01726  472163632551        ERP BCD 3PATTERN IS WRONG                      45008011
01727  456031626066
01730  514645276060
01731  740100306024       DOSE BCD 5(10H DOSE SUMSN10,2E20.8)             45008012
01732  466225006264
01733  446245010073
01734  022502063310
01735  346060606060
01736  740105505051        ROP BCD 4(15H RANDOM NUMBER=N12)               45008013
01737  214524464460
01740  456444222551
01741  134501023460
01742  741030004751     PROBIT BCD 4(8H PROBIT 1ONG,10N5)                 04508014 *
01743  462231630001
01744  004506730100
01745  450334606060
                                  ARRAY STORAGE                           45008200
                  01746 COMMON BSS 7                                      45008201
                  01755  READ  BSS 20                                     04508202
02001  0 00000 0 00000    OSUM                                            45008203
02002  0 00000 0 00000    MSUM                                            45008204
02003  0 00000 0 00000      M1                                            45008205
02004  0 00000 0 00000      M2                                            45008206
02005  0 00000 0 00000      M3                                            45008207
02006  0 00000 0 00000      M4                                            45008208
02007  0 00000 0 00000      M5                                            45008209
02010  0 00000 0 00000    REPC                                            45008215
02011  0 00000 0 00000     REP                                            45008210
                  02101  PROT  BSS 19                                     04508217 *
                                  VARIABLES                               45008300
02012  0 00000 0 00000    XDIM                                            45008310
02013  0 00000 0 00000    YDIM                                            45008311
02014  0 00000 0 00000    TDIM                                            45008312
02015  0 00000 0 00000    XMAX                                            45008313
02016  0 00000 0 00000    MMAX                                            45008314
02017  0 00000 0 00000    YMIN                                            45008315
02020  0 00000 0 00000      X0                                            45008316
02021  0 00000 0 00000      Y0                                            45008317
02022  0 00000 0 00000      X1                                            45008318
02023  0 00000 0 00000      Y1                                            45008319
02024  0 00000 0 00000     X00                                                0320
02025  0 00000 0 00000     Y00                                                0321
02026  0 00000 0 00000    DELX                                            45008322
02027  0 00000 0 00000    DELY                                            45008323
02030  0 00000 0 00000     DEL                                            45008324
02031  0 00000 0 00000      RX                                            45008325
```

```
02032  0 00000 0 00000     RY                                          45008326
02033  0 00000 0 00000     RSQ                                         45008327
02034  0 00000 0 00000     DIA                                         45008328
02035  0 00000 0 00000     DIAY                                        45008329
02036  0 00000 0 00000     YT                                          45008330
02037  0 00000 0 00000     YIP                                         45008331
02040  0 00000 0 00000     MUR                                         45008332
02041  0 00000 0 00000     MUNC                                        45008333
02042  0 00000 0 00000     NSIG                                        45008334
02043  0 00000 0 00000     SIGMA                                       45008335
02044  0 00000 0 00000     GSIG                                        45008336
02045  0 00000 0 00000     RUNTR                                       45008337
                   02046 SIGMAY BSS 1                                 45008338
02047  0 00000 0 00000     X                                               8339
02050  0 00000 0 00000     Y                                               8340
                   02051  OPOP  BSS 1                                 04508341
                   02052  PROG  BSS 1                                 04508342
                                NUMERIC CONSTANTS                      45008500
02053 +0000000000000        ZERO DEC 0                                  45008510
02054 +0000300000001        1F DEC 1                                    45008511
02055 +0000600000002        2F DEC 2                                    45008512
02056 +0000900000005        5F DEC 5                                    45008513
02057 +0000000000010        10F DEC 10                                  45008514
02060 +0000000000014        14F DEC 12                                  45008515
02061 +0000000000143        99F DEC 99.                                 45008516
02062 +0300000000144        100F DEC 100                                45008517
02063 +0000000000310        200F DEC 200                                45008518
02064  0 00006 0 00000      6L HTR 0+0+0                                45008519
02065 +0000000303237        95 DEC 99799                                45008520
02066 +0000000000024        20F DEC 20                                  04508521
                                LOGICAL CONSTANTS AND MASKS            45008600
02067 +0000000700000        LSAD DEC 28672                              45008610
02070  0 00012 0 00012       MOD HTR 10+0+10                            45008611
02071 +2340000000000        PLZ OCT 2340000000000                       45008612
02072 +0000004000000        RHI OCT 4000000                             45008613
02073 -0000000000000        LHI OCT 4000000000000                       45008614
02074 -0000004000000        SIGDI OCT 4000004000000                     45008615
02075 +3777777777777        SIGDM OCT 3777777777777                     45008616
02076 +0000003777777        MASK OCT 3777777                            45008617
02077  0 76100 0 00000      NOP   NOP                                   04508618
02100  0 02000 0 01642      TRA   TRA ADMIN                             04508619
                   00340          END BOX11                           45009999
```

SHARE ASSEMBLER STATISTICS

TAPE	TOTAL	1 FAIL	2 FAIL	3 FAIL	4 FAIL
INP	818	0	0	0	0
LIB	0	0	0	0	0
COR	818	0	0	0	0

NUMBER OF ON-LINE INPUT RECORDS 0

NUMBER OF OFF-LINE PRINT RECORDS 897

NUMBER OF SYMBOLS DEF 179+DEFOP 0+UNDEF 0

09500 HALL W CHEMICAL ON012694 OFF012917 AS TIME012915 AS

SAMPLE INPUT FOR OVERLAY PROGRAM

```
DEC 1,5,3,2,1,0,6,3,0,0,-3,2,0,20,305175781 23,5                    CARD   1
DEC 1,40,80,120,160                                                 CARD   2
DEC 200,190,180                                                     CARD 3-1
DEC 150,140,130                                                     CARD 3-2
DEC 100,90,80                                                       CARD 3-3
DEC 60,50,40                                                        CARD 3-4
DEC 10,6,0                                                          CARD 3-5
DEC 99999,99999,99999,99999,99999,99999,99999,99999,99999,99999     CARD   4
DEC 1,5,3,2,1,0,-6,0,0,0,-3,2,0,40,0,4                              CARD   1
DEC 1,20,80,190                                                     CARD   2
DEC 200,190,180                                                     CARD 3-1
DEC 150,140,130                                                     CARD 3-2
DEC 100,90,80                                                       CARD 3-3
DEC 60,50,40                                                        CARD 3-4
DEC 10,6,0                                                          CARD 3-5
DEC 99999,99999,99999,99999,99999,99999,99999,99999,99999,99999     CARD   4
DEC 6,6                                                             CARD 5-1
DEC 14,7                                                            CARD 5-1
DEC 10,6                                                            CARD 5-6
DEC 0,0                                                             CARD 5-7
DEC 6,6                                                             CARD 5-1
DEC 6,7                                                             CARD 5-2
DEC 6,8                                                             CARD 5-3
DEC 8,6                                                             CARD 5-4
DEC 10,6                                                            CARD 5-6
DEC 14,6                                                            CARD 5-7
DEC 0,0                                                             CARD 5-9
DEC 1,5,3,2,1,0,-6,0,0,0,-3,2,0,40,0,0                              CARD   1
DEC 200,190,180                                                     CARD 3-1
DEC 150,140,130                                                     CARD 3-2
DEC 100,90,80                                                       CARD 3-3
DEC 60,50,40                                                        CARD 3-4
DEC 10,6,0                                                          CARD 3-5
DEC 99999,99999,99999,99999,99999,99999,99999,99999,99999,99999     CARD   4
DEC 6,7                                                             CARD 5-1
DEC 8,8                                                             CARD 5-2
DEC 6,8                                                             CARD 5-4
DEC 8,6                                                             CARD 5-6
DEC 9,6                                                             CARD 5-5
DEC 2,11                                                            CARD 5-6
DEC 0,0                                                             CARD 5-7
DEC 1,10                                                            CARD 5-1
DEC 5,6                                                             CARD 5-2
DEC 3,5                                                             CARD 5-3
DEC 10,4                                                            CARD 5-4
DEC 9,6                                                             CARD 5-5
DEC 8,13                                                            CARD 5-6
DEC 11,10                                                           CARD 5-7
DEC 0,0                                                             CARD 5-8
DEC 1,5,3,2,1,0,6,3,0,0,3,2,0,50,305175781 23,0                     CARD   1
DEC 200,190,180                                                     CARD 3-1
DEC 150,140,130                                                     CARD 3-2
DEC 100,90,80                                                       CARD 3-3
DEC 60,50,40                                                        CARD 3-4
DEC 10,6,0                                                          CARD 3-5
DEC 99999,99999,99999,99999,99999,99999,99999,99999,99999,99999     CARD   4
DEC 1,5,3,2,1,1,6,0,3,3,3,2,1,20,305175781 25,0                     CARD   1
DEC 200,190,180                                                     CARD 3-1
DEC 150,140,130                                                     CARD 3-2
DEC 100,90,80                                                       CARD 3-3
DEC 60,50,40                                                        CARD 3-4
DEC 10,6,0                                                          CARD 3-5
DEC 99999,99999,99999,99999,99999,99999,99999,99999,99999,99999     CARD   4
```

MACHINE OUTPUT FROM OVERLAY PROGRAM FOR SAMPLE PROBLEMS PAGE 1

```
      JOB 04500FV HALL W FINAL OVERLAY ROUTINE AUGUST 11, 1961
      LOD 0                                                    9977
00403 OCT 302123002102
01443 OCT 053400202052
01430 OCT 034000202101
01454 OCT 040000100174
01742 OCT 741030004751
      TRA
```

INPUT 1 5 3 3 1 0 4 3 0 0 3 2 0 2 0 3 0 3 1 7 5 7 8 1 2 3 5

MACHINE OUTPUT FROM OVERLAY PROGRAM FOR SAMPLE PROBLEMS PAGE 2

RUN 1 OF 2
DOSE SUMS 2332 0.699600000E 04 0.699600000E 04

CLASS	0	24	48	72	96	120	144	168	192	216
INSIDE	20	0	0	3	1	0	1	9	2	0
OUTSIDE	84	3	2	1	3	1	0	1	0	0

CLASS	240	264	288	312	336	360	384	408	432	456
INSIDE	0	2	1	2	0	1	0	0	0	2
OUTSIDE	0	0	0	0	0	0	0	0	0	0

PROBIT 10^4 3 6 10 1 20 0 0 0 0 0 0 0 0 0 0 0 0 0 0

CLASS	0	24	48	72	96	120	144	168	192	216
INSIDE	49	29	29	29	26	25	20	19	10	8
OUTSIDE	95	11	8	6	5	2	1	1	0	0

CLASS	240	264	288	312	336	360	384	408	432	456
INSIDE	8	8	6	5	3	3	2	2	2	2
OUTSIDE	0	0	0	0	0	0	0	0	0	0

MOMENTS ARE 0.48583332E 02 0.11468111E 05 0.342914 63E 07 0.12016983E 10 0.46980759E 12
RANDOM NUMBER= 16878292595

RUN 2 OF 2
DOSE SUMS 2332 0.699600000E 04 0.699600000E 04

CLASS	0	24	48	72	96	120	144	168	192	216
INSIDE	16	9	7	2	0	6	0	5	2	4
OUTSIDE	87	2	0	2	0	2	0	2	0	0

CLASS	240	264	288	312	336	360	384	408	432	456
INSIDE	0	0	1	4	0	1	0	0	0	1
OUTSIDE	0	0	0	0	0	0	0	0	0	0

PROBIT 10^3 2 11 8 0 20 0 0 0 0 0 0 0 0 0 0 0 0 0 0

CLASS	0	24	48	72	96	120	144	168	192	216
INSIDE	49	33	33	26	24	24	18	18	13	11
OUTSIDE	95	8	6	6	4	4	2	2	0	0

CLASS	240	264	288	312	336	360	384	408	432	456
INSIDE	7	7	7	6	2	2	1	1	1	1
OUTSIDE	0	0	0	0	0	0	0	0	0	0

MOMENTS ARE 0.48583332E 02 0.11179277E 05 0.31365839E 07 0.10010499E 10 0.34965611E 12
RANDOM NUMBER= 12118138651

MACHINE OUTPUT FROM OVERLAY PROGRAM FOR SAMPLE PROBLEMS PAGE 3

INPUT 1 5 3 2 1 0 -6 0 0 0 -3 2 0 40 0 4

RUN 1 OF 2
DOSE SUMS 2332 0.69960000E 04 0.46640000E 04

CLASS	0	10	20	30	40	50	60	70	80	90
INSIDE	40	0	0	0	0	0	0	0	1	0
OUTSIDE	150	2	0	0	2	0	0	0	1	2
CLASS	100	110	120	130	140	150	160	170	180	190
INSIDE	0	0	0	1	0	0	0	1	2	2
OUTSIDE	0	2	0	1	0	0	0	1	0	0
CLASS	200	210	220	230	240	250	260	270	280	290
INSIDE	0	0	0	0	0	0	0	2	0	2
OUTSIDE	0	0	0	0	0	0	0	0	0	0
CLASS	300	310	320	330	340	350	360	370	380	390
INSIDE	0	0	0	0	0	0	0	2	0	2
OUTSIDE	0	0	0	0	0	0	0	0	0	0

PROBIT 190 2 4 12 8 0 0 0 0 0 0 0 0 0 0 0 0 0 0

CLASS	0	10	20	30	40	50	60	70	80	90
INSIDE	55	15	15	15	15	15	15	15	15	14
OUTSIDE	161	11	9	9	9	7	7	7	7	6
CLASS	100	110	120	130	140	150	160	170	180	190
INSIDE	14	14	14	14	13	13	13	13	12	10
OUTSIDE	4	4	2	2	1	1	1	1	0	0
CLASS	200	210	220	230	240	250	260	270	280	290
INSIDE	8	8	8	8	8	8	8	8	6	6
OUTSIDE	0	0	0	0	0	0	0	0	0	0
CLASS	300	310	320	330	340	350	360	370	380	390
INSIDE	4	4	4	4	4	4	4	4	2	2
OUTSIDE	0	0	0	0	0	0	0	0	0	0

MOMENTS ARE 0.21592592E 02 0.94517777E 04 0.16341232E 07 0.53696884E 09 0.18596196E 12
RANDOM NUMBER= 1218130651

MACHINE OUTPUT FROM OVERLAY PROGRAM FOR SAMPLE PROBLEMS PAGE 4

RUN 2 OF 2
DOSE SUMS 2332 0.69960000E 04 0.11660000E 03

CLASS	0	23	46	69	92	115	138	161	184	207
INSIDE	25	1	0	1	1	2	0	3	3	1
OUTSIDE	151	1	1	2	0	1	2	1	2	0
CLASS	230	253	276	299	322	345	368	391	414	437
INSIDE	1	2	0	2	0	1	2	1	1	0
OUTSIDE	0	0	0	0	0	0	0	0	0	0
CLASS	460	483	506	529	552	575	598	621	644	667
INSIDE	0	0	2	0	2	0	0	1	0	0
OUTSIDE	0	0	0	0	0	0	0	0	0	0
CLASS	690	713	736	759	782	805	828	851	874	897
INSIDE	1	0	0	1	0	0	0	0	1	0
OUTSIDE	0	0	0	0	0	0	0	0	0	0
PROBIT 176	0	6	15	9	0	0	0	0	0	0
CLASS	0	23	46	69	92	115	138	161	184	207
INSIDE	55	30	29	29	28	27	25	25	22	19
OUTSIDE	161	10	9	8	6	6	5	3	2	0
CLASS	230	253	276	299	322	345	368	391	414	437
INSIDE	18	17	15	15	13	13	12	10	9	8
OUTSIDE	0	0	0	0	0	0	0	0	0	0
CLASS	460	483	506	529	552	575	598	621	644	667
INSIDE	8	8	8	6	6	4	4	4	3	3
OUTSIDE	0	0	0	0	0	0	0	0	0	0
CLASS	690	713	736	759	782	805	828	851	874	897
INSIDE	3	2	2	2	1	1	1	1	1	0
OUTSIDE	0	0	0	0	0	0	0	0	0	0

MOMENTS ARE 0.53981481E 02 0.23600481E 05 0.13373762E 08 0.87451287E 10 0.62219984E 13
RANDOM NUMBER= 1218138651

MACHINE OUTPUT FROM OVERLAY PROGRAM FOR SAMPLE PROBLEMS PAGE 5

INPUT 1 9 3 2 1 0 -6 0 0 0 -3 2 0 40 0 0

RUN 1 OF 2
DOSE SUMS 2332 0.69960000E 04 0.13992000E 05

CLASS	0	16	32	48	64	80	96	112	128	144
INSIDE	13	0	0	0	0	1	1	1	2	1
OUTSIDE	143	0	3	5	2	4	0	0	1	0
CLASS	160	176	192	208	224	240	256	272	288	304
INSIDE	1	10	2	0	0	1	3	0	0	1
OUTSIDE	0	1	1	1	0	0	0	0	0	0
CLASS	320	336	352	368	384	400	416	432	448	464
INSIDE	3	2	2	3	0	1	0	0	1	0
OUTSIDE	0	0	0	0	0	0	0	0	0	0
CLASS	480	496	512	528	544	560	576	592	608	624
INSIDE	0	0	0	1	0	1	0	3	1	0
OUTSIDE	0	0	0	0	0	0	0	0	0	0
CLASS	0	16	32	48	64	80	96	112	128	144
INSIDE	55	42	42	42	42	42	41	40	39	37
OUTSIDE	161	18	18	15	10	8	4	4	4	3
CLASS	160	176	192	208	224	240	256	272	288	304
INSIDE	36	35	25	23	23	23	22	19	19	19
OUTSIDE	3	3	2	1	0	0	0	0	0	0
CLASS	320	336	352	368	384	400	416	432	448	464
INSIDE	18	15	13	11	8	8	7	7	7	6
OUTSIDE	0	0	0	0	0	0	0	0	0	0
CLASS	480	496	512	528	544	560	576	592	608	624
INSIDE	6	6	6	6	5	5	4	4	1	0
OUTSIDE	0	0	0	0	0	0	0	0	0	0

MOMENTS ARE 0.64777777E 02 0.22033222E 05 0.94159760E 07 0.45754527E 10 0.23992750E 13
RANDOM NUMBER= 1218138651

MACHINE OUTPUT FROM OVERLAY PROGRAM FOR SAMPLE PROBLEMS PAGE 6

RUN 2 OF 2

DOSE SUMS	2332	0.69960000E 04	0.16323999E 05						
	0	33	66	99	132	165	198	231	264	297
CLASS	25	1	1	2	0	6	2	0	1	1
INSIDE	149	4	2	1	0	1	1	1	0	2
OUTSIDE										
	330	363	396	429	462	495	528	561	594	627
CLASS	0	2	0	1	0	1	1	0	1	1
INSIDE	0	0	0	0	0	0	0	0	0	0
OUTSIDE										
	660	693	726	759	792	825	858	891	924	957
CLASS	1	0	0	1	0	1	1	0	2	0
INSIDE	0	0	0	0	0	0	0	0	0	0
OUTSIDE										
	990	1023	1056	1089	1122	1155	1188	1221	1254	1287
CLASS	0	0	0	1	1	0	0	0	0	1
INSIDE	0	0	0	0	0	0	0	0	0	0
OUTSIDE										
	0	33	66	99	132	165	198	231	264	297
CLASS	55	30	29	28	26	26	20	18	18	17
INSIDE	161	12	8	6	5	5	4	3	2	2
OUTSIDE										
	330	363	396	429	462	495	528	561	594	627
CLASS	16	16	14	14	13	13	12	11	11	10
INSIDE	0	0	0	0	0	0	0	0	0	0
OUTSIDE										
	660	693	726	759	792	825	858	891	924	957
CLASS	9	8	8	8	7	7	6	5	5	3
INSIDE	0	0	0	0	0	0	0	0	0	0
OUTSIDE										
	990	1023	1056	1089	1122	1155	1188	1221	1254	1287
CLASS	3	3	3	3	2	1	1	1	1	1
INSIDE	0	0	0	0	0	0	0	0	0	0
OUTSIDE										

MOMENTS ARE 0.75574073E 02 0.51506407E 05 0.45316290E 08 0.44741935E 11 0.47057766E 14

RANDOM NUMBER= 1218138651

MACHINE OUTPUT FROM OVERLAY PROGRAM FOR SAMPLE PROBLEMS PAGE 7

INPUT	1	5	3	2	1	0	6	3	0	0	3	2	0	50	30517578123	0
X=	22															
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0														
X=	20															
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0														
X=	18															
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0														
X=	16															
	0	0	0	0	0	0	0	0	5	10	12	10	6	0		
	0	0														
X=	14															
	0	0	0	40	50	100	100	100	50	40						
	0	0														
X=	12															
	0	0	0	-86	-100	-186	-180	-180	-90	-80						
	0	0														
X=	10															
	0	0	40	-180	-200	-330	-320	-280	-140	-130						
	0	0														
X=	8															
	0	0	80	-270	-290	-470	-460	-380	-190	-180						
	0	0														
X=	6															
	0	0	130	-140	-150	-140	-130	-0	-0	-0						
	0	0														
X=	4															
	0	0	180	-190	-200	-190	-180	-0	-0	-0						
	0	0														
X=	2															
	0	0	0	-0	-0	-0	-0	-0	-0	-0						
	0	0														
X=	0															
	0	0	0	-0	-0	-0	-0	-0	-0	-0						
	0	0														

MACHINE OUTPUT FROM OVERLAY PROGRAM FOR SAMPLE PROBLEMS PAGE 8

RUN 1 OF 2
DOSE SUMS 2332 0.699600000E 04 0.699600000E 04

CLASS	0	10	20	30	40	50	60	70	80	90
INSIDE	20	0	0	0	0	0	0	0	2	1
OUTSIDE	81	3	0	0	3	2	0	0	1	0
CLASS	100	110	120	130	140	150	160	170	180	190
INSIDE	1	0	0	2	3	1	0	0	6	3
OUTSIDE	3	0	0	1	0	0	0	0	1	0
CLASS	200	210	220	230	240	250	260	270	280	290
INSIDE	2	0	0	0	0	0	0	1	1	1
OUTSIDE	0	0	0	0	0	0	0	0	0	0
CLASS	300	310	320	330	340	350	360	370	380	390
INSIDE	0	0	1	1	0	0	0	0	1	0
OUTSIDE	0	0	0	0	0	0	0	0	0	0
CLASS	400	410	420	430	440	450	460	470	480	490
INSIDE	0	0	0	0	0	0	1	1	0	0
OUTSIDE	0	0	0	0	0	0	0	0	0	0
CLASS	0	10	20	30	40	50	60	70	80	90
INSIDE	40	29	29	29	29	29	29	29	29	27
OUTSIDE	95	14	11	11	11	8	6	6	6	5
CLASS	100	110	120	130	140	150	160	170	180	190
INSIDE	26	25	25	25	23	20	19	19	19	13
OUTSIDE	5	2	2	2	1	1	1	1	1	0
CLASS	200	210	220	230	240	250	260	270	280	290
INSIDE	10	8	8	8	8	8	8	8	7	6
OUTSIDE	0	0	0	0	0	0	0	0	0	0
CLASS	300	310	320	330	340	350	360	370	380	390
INSIDE	5	5	5	4	3	3	3	3	3	2
OUTSIDE	0	0	0	0	0	0	0	0	0	0
CLASS	400	410	420	430	440	450	460	470	480	490
INSIDE	2	2	2	2	2	2	2	1	0	0
OUTSIDE	0	0	0	0	0	0	0	0	0	0

MOMENTS ARE 0.48583332E 02 0.11468111E 05 0.34291463E 07 0.12016983E 10 0.46580759E 12
RANDOM NUMBER= 16878292595

MACHINE OUTPUT FROM OVERLAY PROGRAM FOR SAMPLE PROBLEMS PAGE 9

X=	22									
	0	0	0	0	0	0	0	0	0	0
	0	0								
X=	20									
	0	0	0	0	0	0	0	0	0	0
	0	0								
X=	18									
	0	0	0	0	0	0	0	0	0	0
	0	0								
X=	16									
	0	0	0	0	0	0	0	0	0	0
	0	0								
X=	14									
	0	0	0	0	0	6	10	6	0	0
	0	0								
X=	12									
	0	0	0	-6	-50	-56	-60	-56	-50	-6
	0	0								
X=	10									
	0	0	40	-50	-140	-140	-180	-140	-140	-50
	40	0								
X=	8									
	0	0	80	-90	-230	-230	-310	-230	-230	-90
	80	0								
X=	6									
	0	0	120	-140	-330	-330	-460	-330	-330	-140
	130	0								
X=	4									
	0	0	180	-190	-200	-190	-360	-190	-200	-190
	180	0								
X=	2									
	0	0	0	-0	-0	-0	-0	-0	-0	-0
	0	0								
X=	0									
	0	0	0	-0	-0	-0	-0	-0	-0	-0
	0	0								

MACHINE OUTPUT FROM OVERLAY PROGRAM FOR SAMPLE PROBLEMS PAGE 10

RUN 2 OF 2
DOSE SUMS 2332 0.69960000E 04 0.69960000E 04

CLASS	0	10	20	30	40	50	60	70	80	90
INSIDE	16	0	0	0	0	6	1	0	0	2
OUTSIDE	86	1	0	0	2	0	0	0	2	0
CLASS	100	110	120	130	140	150	160	170	180	190
INSIDE	0	0	0	0	6	1	0	0	1	4
OUTSIDE	0	0	0	2	0	0	0	0	2	0
CLASS	200	210	220	230	240	250	260	270	280	290
INSIDE	2	0	0	4	0	0	0	0	0	0
OUTSIDE	0	0	0	0	0	0	0	0	0	0
CLASS	300	310	320	330	340	350	360	370	380	390
INSIDE	0	1	0	4	0	0	1	0	0	0
OUTSIDE	0	0	0	0	0	0	0	0	0	0
CLASS	400	410	420	430	440	450	460	470	480	490
INSIDE	0	0	0	0	0	0	1	0	0	0
OUTSIDE	0	0	0	0	0	0	0	0	0	0
CLASS	0	10	20	30	40	50	60	70	80	90
INSIDE	49	33	33	33	33	33	27	26	26	26
OUTSIDE	95	9	8	6	8	6	6	6	6	4
CLASS	100	110	120	130	140	150	160	170	180	190
INSIDE	24	24	24	24	24	18	18	18	18	17
OUTSIDE	4	4	4	4	2	2	2	2	2	0
CLASS	200	210	220	230	240	250	260	270	280	290
INSIDE	13	11	11	11	7	7	7	7	7	7
OUTSIDE	0	0	0	0	0	0	0	0	0	0
CLASS	300	310	320	330	340	350	360	370	380	390
INSIDE	7	7	6	6	2	2	2	1	1	1
OUTSIDE	0	0	0	0	0	0	0	0	0	0
CLASS	400	410	420	430	440	450	460	470	480	490
INSIDE	1	1	1	1	1	1	1	0	0	0
OUTSIDE	0	0	0	0	0	0	0	0	0	0

MOMENTS 0.[illegible]E 02 0.11179277[illegible] 05 0.31355879E 07 0.10010459E 10 0.34969611E 12
RANDOM NO. [illegible]

MACHINE OUTPUT FROM OVERLAY PROGRAM FOR SAMPLE PROBLEMS PAGE 11

INPUT	1	5	3	2	1	1	6	0	3	3	3	2	1	20	30517578125	0
X=	22															
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0			
X=	20															
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0			
X=	18															
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0			
X=	16															
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	10
	6	0	0	0	0	0	0	0	0	0	0	0	0			
X=	14															
	0	0	0	0	0	0	0	0	0	0	0	0	46	66	76	
	56	40	0	0	0	0	0	0	0	0	0	0	0			
X=	12															
	0	0	0	0	0	0	0	0	0	0	40	170	200	-210		
	180	120	0	0	0	0	0	0	0	0	0	0				
X=	10															
	0	0	0	0	0	0	-0	-80	-200	-330	-340					
	-310	-210	-0	-0	0	0	0	0	0							
X=	8															
	0	0	0	0	-0	-0	-130	-450	-480	-490						
	-460	-310	-0	-0	-0	0	0	0								
X=	6															
	0	0	0	-0	-0	-0	-180	-370	-390	-390						
	-370	-180	-0	-0	-0	-0	0	0								
X=	4															
	0	0	0	0	-0	-0	-0	-0	-0	-0						
	-0	-0	-0	-0	-0	0	0	0								
X=	2															
	0	0	0	0	0	-0	-0	-0	-0	-0						
	-0	-0	-0	-0	0	0	0	0								
X=	0															
	0	0	0	0	0	0	0	0	0	0						
	0	0	0	0	0	0	0	0								

MACHINE OUTPUT FROM OVERLAY PROGRAM FOR SAMPLE PROBLEMS PAGE 12

RUN 1 OF 2

DOSE SUMS	1166	0.699600000E 04		0.699600000E 04						
CLASS	0	26	52	78	104	130	156	182	208	234
INSIDE	26	0	0	1	0	1	2	0	2	0
OUTSIDE	151	3	3	0	1	0	2	1	0	0
CLASS	260	286	312	338	364	390	416	442	468	494
INSIDE	0	3	1	1	2	2	0	2	2	0
OUTSIDE	0	0	0	0	0	0	0	0	0	0
CLASS	0	26	52	78	104	130	156	182	208	234
INSIDE	55	19	19	19	18	18	17	15	15	13
OUTSIDE	161	10	7	4	4	3	3	1	0	0
CLASS	260	286	312	338	364	390	416	442	468	494
INSIDE	13	13	10	9	8	6	4	4	2	0
OUTSIDE	0	0	0	0	0	0	0	0	0	0

MOMENTS ARE 0.32380808E 02 0.10555814E 05 0.39489160E 07 0.15839713E 10 0.66305223E 12
RANDOM NUMBER= 2355361645

MACHINE OUTPUT FROM OVERLAY PROGRAM FOR SAMPLE PROBLEMS PAGE 13

X=	22									
	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0		
X=	20									
	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0		
X=	18									
	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0		
X=	16									
	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0		
X=	14									
	0	0	0	0	6	10	6	0	6	16
	16	6	0	0	0	0	0	0		
X=	12									
	0	0	0	40	50	60	50	80	90	-110
	110	90	40	0	0	0	0	0		
X=	10									
	0	0	0	80	90	-100	-90	-160	-170	-190
	-190	-170	-80	-0	0	0	0	0		
X=	8									
	0	0	0	130	-140	-150	-140	-260	-270	-290
	-290	-270	-130	-0	-0	0	0	0		
X=	6									
	0	0	0	-180	-190	-200	-190	-360	-370	-390
	-390	-370	-180	-0	-0	-0	0	0		
X=	4									
	0	0	0	0	-0	-0	-0	-0	-0	-0
	-0	-0	-0	-0	-0	0	0	0		
X=	2									
	0	0	0	0	0	-0	-0	-0	-0	-0
	-0	-0	-0	-0	0	0	0	0		
X=	0									
	0	0	0	0	0	0	0	0	0	-0
	0	0	0	0	0	0	0	0		

MACHINE OUTPUT FROM OVERLAY PROGRAM FOR SAMPLE PROBLEMS PAGE 14

RUN 2 OF 2
DOSE SUMS 1166 0.699960000E 04 0.699960000E 04

CLASS	0	20	40	60	80	100	120	140	160	180
INSIDE	27	0	0	0	2	2	1	3	3	6
OUTSIDE	149	0	4	1	5	1	1	0	0	0
CLASS	200	220	240	260	280	300	320	340	360	380
INSIDE	1	0	0	3	2	0	0	0	3	2
OUTSIDE	0	0	0	0	0	0	0	0	0	0
CLASS	0	20	40	60	80	100	120	140	160	180
INSIDE	55	28	28	28	28	26	24	23	20	17
OUTSIDE	161	12	12	8	7	2	1	0	0	0
CLASS	200	220	240	260	280	300	320	340	360	380
INSIDE	11	10	10	10	7	5	5	5	5	2
OUTSIDE	0	0	0	0	0	0	0	0	0	0

MOMENTS ARE 0.323888888E 02 0.74798888E 04 0.21079493E 07 0.665672196 09 0.2246d800E 12
RANDOM NUMBER= 4945649805
END OF JOB

JOB 04500FV HALL W FINAL OVE350320 CC

04500FV HALL W FINAL OVE ON350320 OFF350445 AS TIME CC

Appendix 2A

Description of Program Using Analytic Dissemination Function

The function of the program can be told quite briefly. Into a rectangular target area of arbitrary dimensions munitions are distributed in any one of three ways, viz., their co-ordinates may be read in, or they may be generated in either a uniform random or an elliptical normal pattern. At each point of a sampling grid, which normally is superimposed upon the target area, the total dosage is computed, using the equation

$$D(x,y,T) = \left\{ \frac{\lambda \bar{u}^{\beta-1} Q_o \left[1 - ae^{-b\left(T - \frac{x}{\bar{u}}\right)}\right] e^{-\left[\frac{\bar{u}^{\beta} y^2}{k_y(x^{\beta} + \alpha_y \bar{u}^{\beta})}\right]}}{\pi \sqrt{K_y K_z (x^{\beta} + \alpha_y \bar{u}^{\beta})(x^{\beta} + \alpha_z \bar{u}^{\beta})}} \right\} \left\{ \operatorname{erf}\left[(\bar{u} T \pm x) \sqrt{\frac{\bar{u}^{\beta}}{k_x(x^{\beta} + \alpha_x \bar{u}^{\beta})}}\right] + \operatorname{erf}\left[x \sqrt{\frac{\bar{u}^{\beta}}{k_x(x^{\beta} + \alpha_x \bar{u}^{\beta})}}\right] \right\}$$

Dosage is converted to dose by the application of a breathing function and the probability of a casualty, P_c, is assayed by means of an arbitrary dose threshold or by employing the probit method.

When the probit method is used the program scores the P_c values in a sixteen-bar histogram and also computes the first five moments at the P_c distribution.

Several important program controls should be discussed at this point. The parameter ITRAT, when larger than one, causes the entire program to be repeated until this parameter is counted down to one or until the control exercised by the parameter EPS (ε) intervenes. Prior to each iteration the parameters SUMX and SUMY are augmented by the parameters DELSX and DELSY respectively, thus increasing the density of points in the sampling grid. The parameter EPS, when zero, sends the program to the dose threshold scheme of casualty determination.

Whenever the arithmetic mean of P_c for an iteration is different from that for the previous iteration by an amount less than EPS, the run is terminated, final prints of histogram and moments are made, and the next run is sought. If all iterations called for are done and the EPS criterion has not been met, the last two moments sets are printed.

All doses and P_c will be printed if PROPT is other then zero. This parameter is also consulted in order to guarantee the printing of the histogram

and moments when certain paths are traversed.

When N is one, a single munition is placed at zero, zero and the dose along each ordinate is printed in fixed point, scaled so that the largest dose will not equal or exceed 2^{17} nor be smaller than zero. This output is then useful as a udg [illegible] the overlay program.

A starting random number may be introduced in octal form into the cell RANDM. If this cell is set to zero, the program assumes the starting random number is already present.

Input is of the variable field type terminated with a TRA 3,4 instruction card. Any number of runs may be placed consecutively. Termination of operation must be accomplished by reading an N of zero followed by TRA 3,4. No other parameters need be input. When munitions are to be read, their coordinates in alternating X and Y are placed immediately after the TRA 3,4 card for the basic parameters and their loading is terminated with TRA 3,4. Errors will result if there are not exactly N coordinate sets.

Output begins with a verification print of the input parameters and continues with a print of the last random number used, if munitions were generated, and the locations of munitions. The numbers of X and Y points in the sampling grid are given next followed by optional dose and P_c print. The P_c values are printed only when the probit method is used in their determination. Finally there is printed the appropriate summary information, such as the histogram and moments.

The breathing function B(T) is currently being computed from the formula $B(T) = C_0 + C_1T + C_2T^2$

Following is a list of the 34 input parameters, whose functions are indicated. An asterisk identifies those quantities which must be in fixed point, and the dagger the one parameter which must be in octal form when used at all. All other numbers must be in floating point, i.e., must have a decimal point unless they are zero.

* N	Number of munitions
* CHOOZ	0: Read, 1: Uniform random, 2: Elliptical normal
AZRO	Minimum x coordinates of target
AONE	Maximum x coordinate of target
BZRO	Minimum y coordinates of target
BONE	Maximum y coordinates of target
A	The "a" of dissemination equation
B	The "b" of dissemination equation

ALFX	These are the subscripted
ALFY	alpha quantities of
ALFZ	the dosage equation
KX	K sub x
KY	K sub y
LMKZ	Lambda over square root of K sub z
BETA	Beta
U	U
QZRQ	Q sub zero
T	Time
CZERO	Breathing function parameter
CONE	Breathing function parameter
BZRO	B sub zero of probit formula
AZRO5	A sub zero minus 5 of probit formula
XZRO	Minimum x coordinate of sampling grid
YZRO	Minimum y coordinate of sampling grid
XMAX	Maximum x coordinate of sampling grid
YMAX	Maximum y coordinate of sampling grid
*SUMX	Number of sampling ordinates
*SUMY	Number of sampling abcissae
*DELSX	Increment to SUMX on iterations
*DELSY	Increment to SUMY on iterations
*ITRAT	Number of iterations of the run
EPS	Epsilon, the arithmetic mean threshold criterion
*PROPT	0: No dose print, 1: Print dose
+RANDM	Starting random number
FCPWR	Width parameter(1)

(1) The "width" on which the histogram counts are made is governed by FCPWR. This fractionation of the interval from zero to one is the inverse of two to the power stored in FCPWR. This power can be any number zero to nine inclusive, thus the interval can range from one to 1/512. Changes in FCPWR must be made in binary.

Appendix 2C

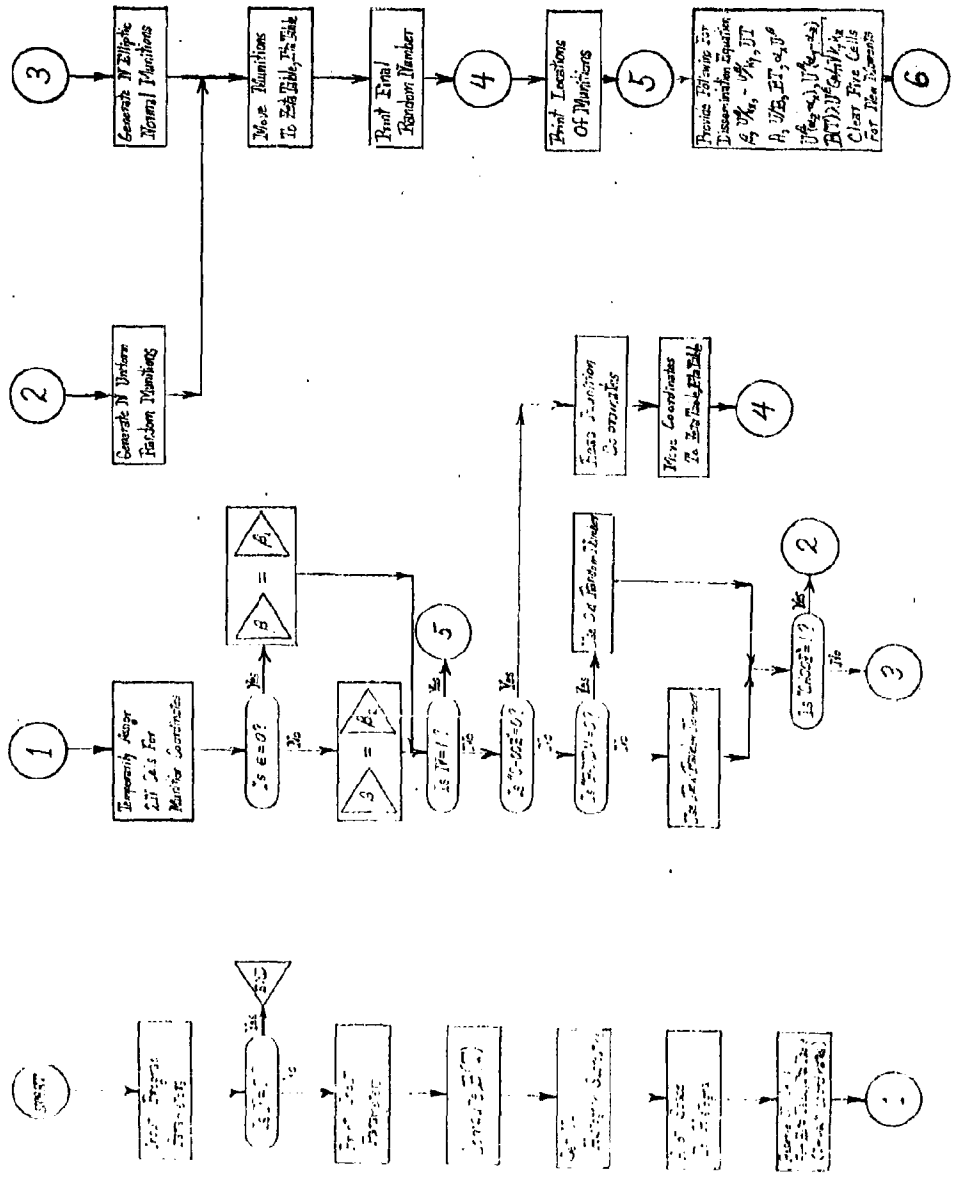
Sample Data

Data card formats for three typical runs are given below. The first run requires two munitions to be read in, the second is a one-munition run for generating a unit dissemination grid, and the third requests generation of 25 munitions distributed in an elliptical normal pattern. Note the dummy run which serves to terminate operation.

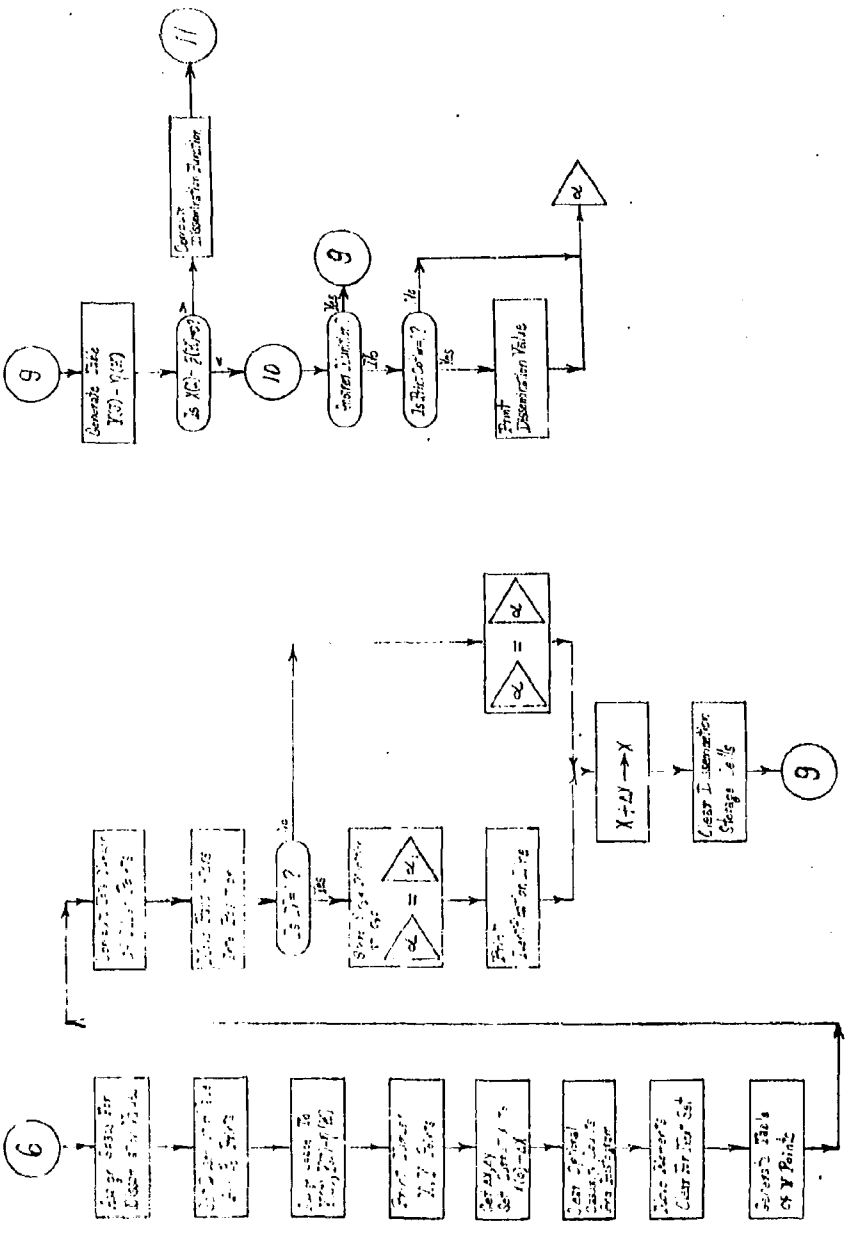
```
DEC     2, 0, 0, 63.0, 0, 34.0, 0, 1.0, 0, 0, 0
DEC     79.183,195.782, .112, 1.75, 120.0, 1.0, 2.0
DEC     .5, 0, 1.0, -4.0, 0, 0, 63.0, 34.0, 64, 35
DEC     0, 0, 1, .0001, 1.0
TRA     3,4
DEC     30.0, 32.0, 40.0, 32.0
TRA     3,4
DEC     1, 0, 0, 63.0, 0, 34.0, 0, 1.0, 0, 0, 0
DEC     79.183, 195.782, .112, 1.75, 120.0, 1.0, 2.0
DEC     15, 0, 0, 0, 0, 0, 63.0, 34.0, 64, 35
DEC     0, 0, 1, 0, 0, 0
TRA     3,4
DEC     25, 2, 0, 850.0, 0, 850.0, .53, 2.9, .29
DEC     .018, .0014, 175.0, 95010, .107, 1.5, 134.0
DEC     34890.7, .05, 1.61968, 0, 1.0, -4.0, 0, 0
DEC     850.0, 850.0, 26, 26, 5, 5, 2, .00001, 1
OCT     34327724615
TRA     3,4
DEC     0
TRA     3,4

REM     END OF JOB
```

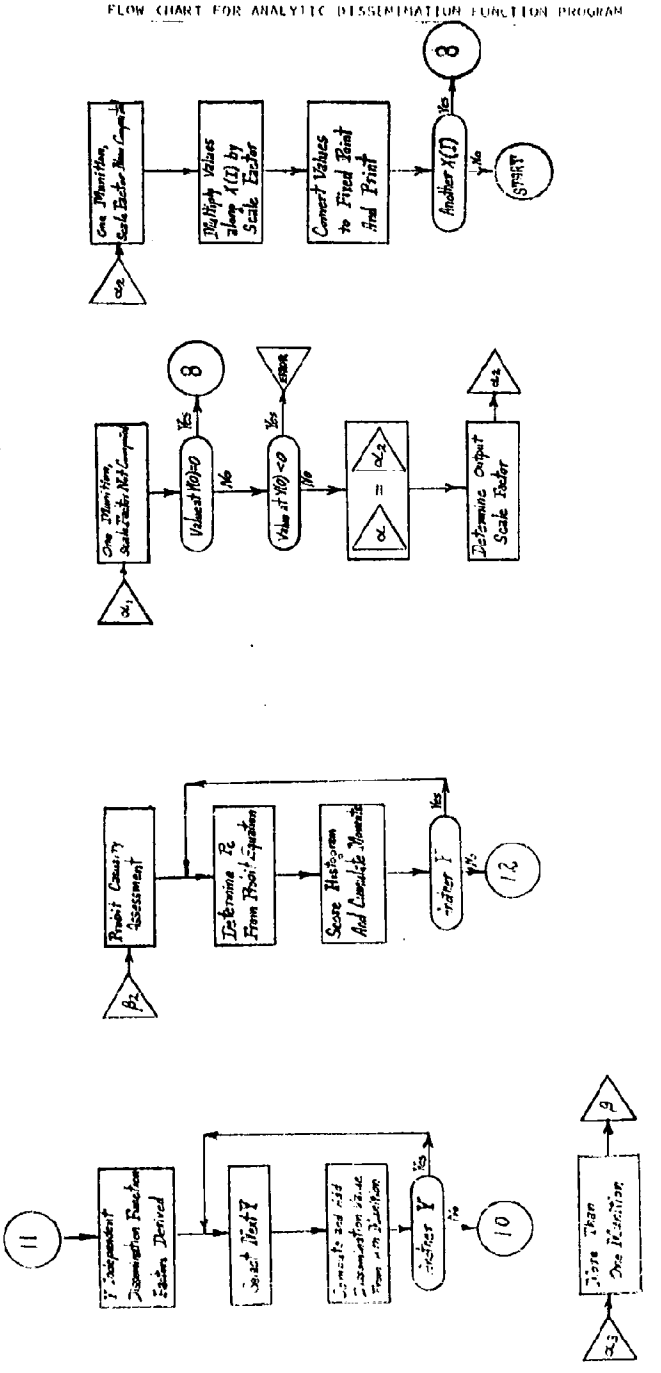
FLOW CHART FOR ANALYTIC DISSEMINATION FUNCTION PROGRAM PAGE 1



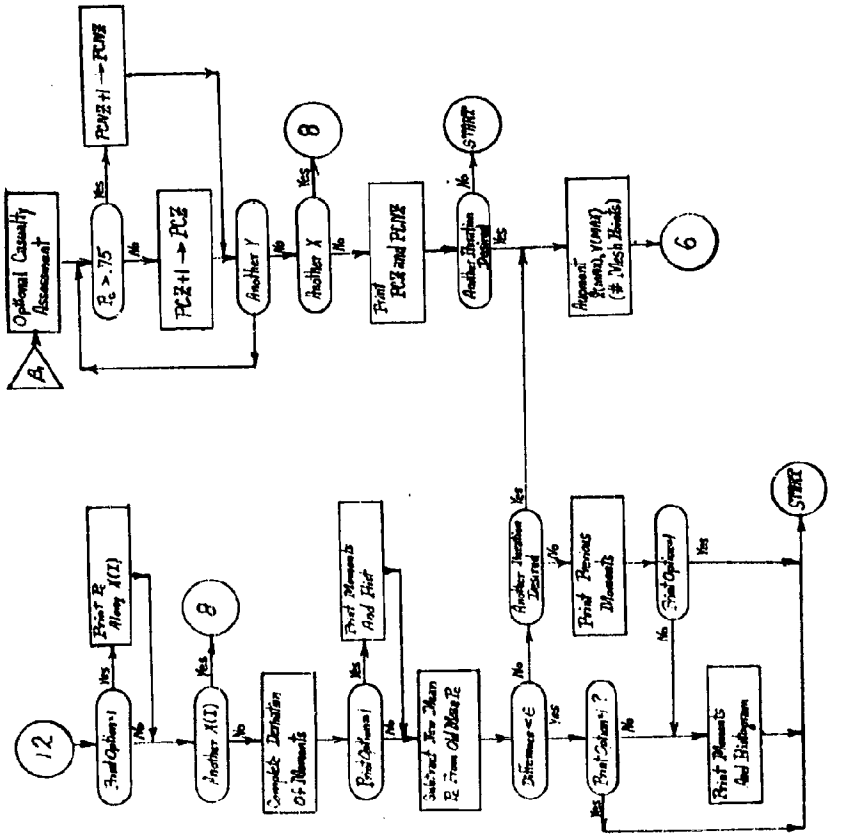
FLOW CHART FOR ANALYTIC DISCRIMINATION FUNCTION PROGRAM PAGE 2



FLOW CHART FOR ANALYTIC DISSEMINATION FUNCTION PROGRAM PAGE 3



FLOW CHART FOR ANALYTIC DISSEMINATION FUNCTION PROGRAM PAGE 4



BESYS 2, SAP 3-7 ASSEMBLY OF ANALYTIC DISSEMINATION FUNCTION PROGRAM PAGE 1

```
                        01000          ORG  512
01000   0 07400 4 70010 START TSX  XINPUT,4          INPUT PROGRAM          45000
01001   0 00060 0 00000       0,0,0                  PARAMETERS
01002  -1 67077 0 67000       MON  N,0,N+63                                 45000
01003   0 50000 0 67000 NADDR CLA  N                                        45000
01004  -0 10000 0 01006       TNZ  *+2                                      45000
01005   0 07400 4 70024       TSX  ENDJOB,4                                 45000
01006   0 07400 4 70013       TSX  XPRINT,4          FORM SKIP              45000
01007   0 02411 0 02411       PZE  FORM,0,FORM                              45000
01010   0 07400 4 70007       TSX  OUTPUT,4          PRINT PROGRAM          45000
01011   0 00011 0 02501            FORM1,0,9         PARAMETERS             45000
01012  -1 67041 0 67000       MON  N,0,RANDM                                45000
01013   0 07400 4 02102       TSX  BRFA,4            EXIT TO GET BITI       04502
01014   0 60100 0 02370       STO  BSUBT                                    04502
01015   0 50000 0 02316       CLA  NINE              SET UP HISTOGRAM       45000
01016   0 40200 0 02372       SUB  FCPWR             SUBROUTINE
01017   0 76700 0 00011       ALS  9                                        45000
01020   0 60100 0 02356       STO  ADING
01021   0 76700 0 00022       ALS  18                                       45000
01022   0 40000 0 02336       ADD  EXPO                                     45000
01023   0 60100 0 02355       STO  FIXER
01024   0 50000 0 02372       CLA  FCPWR                                    45000
01025   0 62100 0 01027       STA  *+2                                      45000
01026   0 50000 0 02313       CLA  ONE                                      45000
01027   0 76700 0 00000       ALS  **                                       45000
01030   0 60100 0 02346       STO  FCNDX                                    45000
01031   0 40200 0 02313       SUB  ONE                                      45000
01032   0 60100 0 02375       STO  TEMPA                                    45000
01033   0 76700 0 00022       ALS  18                                       45000
01034   0 40000 0 02355       ADD  FIXER                                    45000
01035   0 62200 0 01617       STD  FCA                                      45000
01036   0 50000 0 02375       CLA  TEMPA             GET INTERVAL SIZE      45000
01037   0 40000 0 02313       ADD  ONE               FOR HISTOGRAM          45000
01040   0 40000 0 02335       ADD  FLOTR                                    45000
01041   0 30000 0 02335       FAD  FLOTR                                    45000
01042   0 60100 0 02376       STO  TEMPB                                    45000
01043   0 50000 0 02322       CLA  ONEF                                     45000
01044   0 24100 0 02376       FDP  TEMPB                                    45000
01045  -0 60000 0 02361       STQ  QUT                                      45000
01046   0 50000 0 01003       CLA  NADDR             BEGIN ALLOCATION       45000
01047  -0 32000 0 02333       ANA  MASK              OF UPPER MEMORY        45000
01050   0 62100 0 01465       STA  CLRFC             WITH ASSIGNMENT        45000
01051   0 40200 0 02313       SUB  ONE               OF SPACE TO            45000
01052   0 60100 0 02360       STO  CRNTAD            HISTOGRAM              45000
01053   0 73400 4 00000       PAX  0,4                                      45000
01054  -0 63400 4 01673       SXD  FCD,4                                    45000
01055  -0 63400 4 01774       SXD  FCE,4                                    45000
01056   0 40000 0 02356       ADD  ADING                                    45000
01057   0 62100 0 01621       STA  FCB                                      45000
01060   0 62100 0 01623       STA  FCC                                      45000
01061   0 50000 0 02360       CLA  CRNTAD                                   45000
01062   0 40200 0 02375       SUB  TEMPA                                    45000
01063   0 62100 0 01673       STA  FCD                                      45000
01064   0 62100 0 01774       STA  FCE                                      45000
01065   0 62100 0 01567       STA  ZTBLA             ADDRESS PLUS ONE       45000
01066   0 62100 0 01213       STA  ZTBLB             OF ZETA TABLE          45000
01067   0 62100 0 01153       STA  ZTBLC                                    45000
01070   0 62100 0 01270       STA  ZTBLD                                    45000
01071   0 62100 0 01540       STA  ZTBLE                                    45000
01072   0 40200 0 67000       SUB  N                                        45000
01073   0 62100 0 01562       STA  ETBLA             ADDRESS PLUS ONE       45000
01074   0 62100 0 01231       STA  ETBLB             OF ETA TABLE           45000
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```
01075   0 62100 0 01156          STA ETBLC                                  45000
01076   0 62100 0 01277          STA ETBLD                                  45000
01077   0 62100 0 01541          STA ETBLE                                  45000
01100   0 40200 0 67000          SUB N                                      45000
01101   0 60100 0 02360          STO CRNTAD                                 45000
01102   0 62100 0 01212          STA RNA                                    45000
01103   0 62100 0 01230          STA RNB          ADDRESS PLUS ONE OF       45000
01104   0 62100 0 01267          STA RNC          MUNITION LOCATIONS
01105   0 62100 0 01276          STA RND                                    45000
01106   0 62100 0 01152          STA MTBLA                                  45000
01107   0 62100 0 01155          STA MTBLB                                  45000
01110   0 73400 4 00000          PAX 0,4                                    45000
01111  -0 63400 4 01145          SXD MUNIN,4                                45000
01112   1 77777 4 01113          TXI *+1,4,-1                               45000
01113  -0 63400 4 01311          SXD MLOC,4                                 45000
01114   0 40200 0 67000          SUB N                                      45000
01115   0 40200 0 67000          SUB N                                      45000
01116   0 62100 0 01311          STA MLOC                                   45000
01117   0 62100 0 01145          STA MUNIN                                  45000
01120   0 50000 0 67037          CLA EPS
01121   0 10000 0 01124          TZE *+3          CHOOSE REGULAR OR         45000
01122   0 50000 0 02342          CLA NOP          OPTIONAL CASUALTY         45000
01123   0 02000 0 01125          TRA *+2          DETERMINATION.            45000
01124   0 50000 0 02337          CLA RELA                                   45000
01125   0 60100 0 01577          STO OPTPC                                  45000
01126   0 53400 4 67000          LXA N,4                                    45000
01127  -0 63400 4 02345          SXD KNDX,4       SET INDEX TO              45000
01130   0 50000 0 67003          CLA AONE         MUNITIONS                 45000
01131   0 30200 0 67002          FSB AZRO                                   45000
01132   0 60100 0 02352          STO XSPAN                                  45000
01133   0 50000 0 67005          CLA BONE         STORE DIMENSIONS          45000
01134   0 30200 0 67004          FSB BZRO         OF IMPACT AREA            45000
01135   0 60100 0 02353          STO YSPAN                                  45000
01136   0 50000 0 67000          CLA N                                      45000
01137   0 40200 0 02313          SUB ONE                                    45000
01140   0 10000 0 01312          TZE MLOC+1                                 45000
01141   0 50000 0 67001          CLA CHOOZ                                  45000
01142  -0 10000 0 01162          TNZ GENMU        TEST WHETHER              45000
01143   0 07400 4 70010          TSX XINPUT,4     MUNITIONS READ            45000
01144   0 00000 0 00000                0,0,0      OR GENERATED              45000
01145  -1 00000 0 00000 MUNIN    MON **,0,**                                45000
01146   0 50000 0 67000          CLA N                                      45000
01147   0 76700 0 00001          ALS 1                                      45000
01150   0 73400 4 00000          PAX 0,4                                    45000
01151   0 53400 1 67000          LXA N,1                                    45000
01152   0 50000 4 00000 MTBL*    CLA **,4         MOVE COORDINATES          45000
01153   0 60100 1 00000 ZTBL     STO **,1         OF MUNITIONS TO           45000
01154   1 77777 4 01155          TXI *+1,4,-1     ZETA-ETA TABLES           45000
01155   0 50000 4 00000 MTBLB    CLA **,4                                   45000
01156   0 60100 1 00000 ETBLC    STO **,1                                   45000
01157   1 77777 4 01160          TXI *+1,4,-1                               45000
01160   2 00001 1 01152          TIX MTBLA,1,1                              45000
01161   0 02000 0 01305          TRA PRMUN                                  45000
01162   0 76000 0 00140 GENMU    SLF
01163   0 40200 0 02313          SUB ONE                                    45000
01164  -0 10000 0 01166          TNZ *+2          SENSE LIGHT ON            45000
01165   0 76000 0 00141          SLN 1            FOR UNIFORM RANDOM        45000
01166   0 50000 0 67041          CLA RANDM                                  45000
01167   0 10000 0 01171          TZE *+2                                    45000
01170   0 60100 0 02367          STO RLWRK                                  45000
01171   0 50000 0 67000          CLA N                                      45000
01172   0 76700 0 00001          ALS 1                                      45000
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```
01173  0 73400 4 00000          PAX 0,4                                    45000
01174  0 53400 1 67000          LXA N,1                                    45000
01175 -0 76000 0 00141          SLT 1                                      45000
01176 -3 00014 0 01235  XII     TXL ELIPS,0,12                             45000
01177  0 56000 0 02367  GENRN   LDQ NEWRN                                  45000
01200  0 20000 0 02334          MPY VPOWR      GENERATE RANDOM             45000
01201 -0 60000 0 02367          STQ NEWRN      NUMBERS AND                 45000
01202  0 56000 0 02367          CLA NEWRN      FORM UNIFORMLY
01203  0 77100 0 00010          ARS 8          DISTRIBUTED
01204  0 40000 0 02336          ADD EXPO       SET OF IMPACTS              45000
01205  0 30000 0 02336          FAD EXPO                                   45000
01206  0 60100 0 02375          STO TEMPA                                  45000
01207  0 56000 0 02375          LDQ TEMPA                                  45000
01210  0 26000 0 02352          FMP XSPAN                                  45000
01211  0 30000 0 67002          FAD AZRO
01212  0 60100 4 00000  RNA     STO **,4                                   45000
01213  0 60100 1 00000  ZTBLB   STO **,1                                   45000
01214  1 77777 4 01215          TXI **+1,4,-1                              45000
01215  0 56000 0 02367          LDQ NEWRN                                  45000
01216  0 20000 0 02334          MPY VPOWR                                  45000
01217 -0 60000 0 02367          STQ NEWRN                                  45000
01220  0 50000 0 02367          CLA NEWRN
01221  0 77100 0 00010          ARS 8
01222  0 40000 0 02336          ADD EXPO                                   45000
01223  0 30000 0 02336          FAD EXPO                                   45000
01224  0 60100 0 02375          STO TEMPA                                  45000
01225  0 56000 0 02375          LDQ TEMPA                                  45000
01226  0 26000 0 02353          FMP YSPAN                                  45000
01227  0 30000 0 67004          FAD UZRO                                   45000
01230  0 60100 4 00000  RNB     STO **,4                                   45000
01231  0 60100 1 00000  ETBLB   STO **,1                                   45000
01232  1 77777 4 01233          TXI **+1,4,-1                              45000
01233  2 00001 1 01177          TIX GLNRN,1,1                              45000
01234  0 02000 0 01302          TRA FINRN                                  45000
01235 -0 53400 2 01176  ELIPS   LXD XII,2      FORM ELLIPTICAL             45000
01236  0 60000 0 02373          STZ RXSUM      NORMAL DISTRIBUTION         45000
01237  0 60000 0 02374          STZ RYSUM                                  45000
01240  0 56000 0 02367  RNSUM   LDQ NEWRN                                  45000
01241  0 20000 0 02334          MPY VPOWR                                  45000
01242 -0 60000 0 02367          STQ NEWRN                                  45000
01243  0 50000 0 02367          CLA NEWRN                                  45000
01244  0 77100 0 00010          ARS 8                                      45000
01245  0 40000 0 02336          ADD EXPO                                   45000
01246  0 30000 0 02336          FAD EXPO                                   45000
01247  0 30000 0 02373          FAD RXSUM                                  45000
01250  0 60100 0 02373          STO RXSUM      SUM 12 RN                   45000
01251  0 56000 0 02367          LDQ NEWRN                                  45000
01252  0 20000 0 02334          MPY VPOWR                                  45000
01253 -0 60000 0 02367          STQ NEWRN                                  45000
01254  0 50000 0 02367          CLA NEWRN                                  45000
01255  0 77100 0 00010          ARS 8                                      45000
01256  0 40000 0 02336          ADD EXPO                                   45000
01257  0 30000 0 02336          FAD EXPO                                   45000
01260  0 30000 0 02374          FAD RYSUM                                  45000
01261  0 60100 0 02374          STO RYSUM      SUM 12 RN                   45000
01262  2 00001 2 01240          TIX RNSUM,2,1                              45000
01263  0 50000 0 02373          CLA RXSUM                                  45000
01264  0 24100 0 02327          FDP TWELV                                  45000
01265  0 26000 0 02352          FMP XSPAN                                  45000
01266  0 30000 0 67002          FAD AZRO                                   45000
01267  0 60100 4 00000  RNC     STO **,4       STORE ZETA FOR PRINT        45000
01270  0 60100 1 00000  ZTBLD   STO **,1       STORE ZETA IN ZTBL          45000
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```
01271  1 77777 4 01272        TXI  **+1,4,-1                                  45000
01272  0 50000 0 02374        CLA  RYSUM                                      45000
01273  0 24100 0 02327        FDP  TWELV                                      45000
01274  0 26000 0 02353        FMP  YSPAN                                      45000
01275  0 30000 0 67004        FAD  BZRO                                       45000
01276  0 60100 4 00000 RND    STO  **,4       STORE ETA FOR PRINT             45000
01277  0 60100 1 00000 ETBLD  STO  **,1       STORE ETA IN ETBL               45000
01300  1 77777 4 01301        TXI  **+1,4,-1                                  45000
01301  2 00001 1 01235        TIX  ELIPS,1,1                                  45000
01302  0 07400 4 70007 FINRN  TSX  OUTPUT,4    PRINT FINAL                     45000
01303  0 00011 0 02677        FORML,0,9       RANDOM NUMBER                   45000
01304 -1 02367 0 02367        MON  NEWRN,0,NEWRN                              45000
01305  0 07400 4 70013 PRMUN  TSX  XPRINT,4    PRINT LOCATIONS                 45000
01306  0 02665 0 02662        PZE  FORMJ,0,FORMJ+3  OF MUNITIONS
01307  0 07400 4 70007        TSX  OUTPUT,4                                   45000
01310  0 00011 0 02665        FORMK,0,9                                       45000
01311 -1 00000 0 00000 MLOC   MON  **,0,**                                    45000
01312  0 56000 0 02352        LDQ  XSPAN                                      45000
01313  0 26000 0 02353        FMP  YSPAN                                      45000
01314  0 60100 0 02354        STO  TARGA                                      45000
01315  0 02000 0 01316        TRA  **+1
01316  0 50000 0 67016        CLA  BETA       DERIVE SUTION                   45000
01317  0 60100 0 01516        STO  SUTNA+3    PARAMETERS                      45000
01320  0 50000 0 67017        CLA  U                                          45000
01321  0 07400 4 67106        TSX  LOG,4                                      45000
01322  0 76500 0 00043        LRS  35                                         45000
01323  0 26000 0 67016        FMP  BETA                                       45000
01324  0 07400 4 67101        TSX  EXP,4                                      45000
01325  0 60100 0 02362        STO  UBETA                                      45000
01326  0 24100 0 67013        FDP  KX                                         45000
01327 -0 60000 0 01524        STO  SUTNA+9                                    45000
01330  0 50200 0 02362        CLS  UBETA                                      45000
01331  0 24100 0 67014        FDP  KY                                         45000
01332 -0 60000 0 01522        STO  SUTNA+7                                    45000
01333  0 56000 0 67017        LDQ  U                                          45000
01334  0 26000 0 67021        FMP  T                                          45000
01335  0 60100 0 01525        STO  SUTNA+10                                   45000
01336  0 50000 0 67006        CLA  A                                          45000
01337  0 60100 0 01526        STO  SUTNA+11                                   45000
01340  0 50000 0 67017        CLA  U                                          45000
01341  0 24100 0 67007        FDP  B                                          45000
01342 -0 60000 0 01527        STO  SUTNA+12                                   45000
01343  0 56000 0 67007        LDQ  B                                          45000
01344  0 26000 0 67021        FMP  T                                          45000
01345  0 60100 0 01530        STO  SUTNA+13                                   45000
01346  0 56000 0 67010        LDQ  ALFX                                       45000
01347  0 26000 0 02362        FMP  UBETA                                      45000
01350  0 60100 0 01517        STO  SUTNA+4                                    45000
01351  0 56000 0 67012        LDQ  ALFZ                                       45000
01352  0 26000 0 02362        FMP  UBETA                                      45000
01353  0 30200 0 01517        FSB  SUTNA+4                                    45000
01354  0 60100 0 01520        STO  SUTNA+5                                    45000
01355  0 56000 0 67011        LDQ  ALFY                                       45000
01356  0 26000 0 02362        FMP  UBETA                                      45000
01357  0 30200 0 01520        FSB  SUTNA+5                                    45000
01360  0 30200 0 01517        FSB  SUTNA+4
01361  0 60100 0 01521        STO  SUTNA+6                                    45000
01362  0 50000 0 67014        CLA  KY                                         45000
01363  0 07400 4 67107        TSX  SQRT,4                                     45000
01364  0 24100 0 67015        FDP  LMKZ                                       45000
01365  0 26000 0 02324        FMP  PI                                         45000
01366  0 24100 0 02362        FDP  UBETA                                      45000
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```
01367  0 26000 0 67017        FMP U                                          45000
01370  0 60100 0 02375        STO TEMPA                                      45000
01371  0 50000 0 67020        CLA QZRO                                       45000
01372  0 24100 0 02375        FDP TEMPA                                      45000
01373  0 26000 0 02370        FMP BSUBT          BREATHING FUNCTION
01374  0 60100 0 01523        STO SUTNA+8
01375  0 53400 4 02315        LXA FIVE,4         CLEAR MOMENTS               45000
01376  0 60000 4 02411        STZ NEWM,4                                     45000
01377  2 00001 4 01376        TIX *-1,4,1                                    45000
01400  0 50000 0 02360 RENTR  CLA GRNTAD         RE ENTER TO ALLOCATE        45000
01401  0 62100 0 01555        STA DTBLA          MEMORY TO ACCORD            45000
01402  0 62100 0 01600        STA STEP4          WITH NEW S(X) AND           45000
01403  0 62100 0 01614        STA DTBLD          S(Y), AND GENERATE          04502
01404  0 62100 0 01625        STA DTBLE          NEW PARAMETERS              04502
01405  0 62100 0 01635        STA DTBLF                                      45000
01406  0 60100 0 01515        STO SUTNA+2
01407  0 73400 4 00000        PAX 0,4                                        45000
01410  1 77777 4 01411        TXI *+1,4,-1                                   45000
01411 -0 63400 4 01761        SXD DPRTA,4                                    45000
01412 -0 63400 4 01765        SXD PPRTA,4                                    45000
01413  0 40200 0 67033        SUB SUMY                                       45000
01414  0 62100 0 01761        STA DPRTA                                      45000
01415  0 62100 0 01765        STA PPRTA                                      45000
01416  0 62100 0 01563        STA YDIFA                                      45000
01417  0 60100 0 01514        STO SUTNA+1
01420  0 40200 0 67033        SUB SUMY                                       45000
01421  0 62100 0 01561        STA YTBLA                                      45000
01422  0 62100 0 01500        STA YTBLB                                      45000
01423  0 53400 4 67033        LXA SUMY,4                                     45000
01424 -0 63400 4 02344        SXD YNDX,4                                     45000
01425  0 07400 4 70007        TSX OUTPUT,4       PRINT NUMBER OF
01426  0 00011 0 02710            FORMM,0,9      VALUES OF X AND Y
01427 -1 67033 0 67032        HON SUMX,0,SUMY
01430  0 50000 0 67032        CLA SUMX           COMPUTE DELTA X             45000
01431  0 40200 0 02313        SUB ONE            AND DELTA Y                 45000
01432  0 40000 0 02335        ADD FLOTR                                      45000
01433  0 30000 0 02335        FAD FLOTR                                      45000
01434  0 60100 0 02375        STO TEMPA                                      45000
01435  0 50000 0 67030        CLA XMAX                                       45000
01436  0 30200 0 67026        FSB XZRO                                       45000
01437  0 24100 0 02375        FDP TEMPA                                      45000
01440 -0 60000 0 02350        STO INCRX                                      45000
01441  0 50000 0 67033        CLA SUMY                                       45000
01442  0 40200 0 02313        SUB ONE                                        45000
01443  0 40000 0 02335        ADD FLOTR                                      45000
01444  0 30000 0 02335        FAD FLOTR                                      45000
01445  0 60100 0 02375        STO TEMPA                                      45000
01446  0 50000 0 67031        CLA YMAX                                       45000
01447  0 30200 0 67027        FSB YZRO                                       45000
01450  0 24100 0 02375        FDP TEMPA                                      45000
01451 -0 60000 0 02351        STO INCRY                                      45000
01452  0 50000 0 67026        CLA XZRO                                       45000
01453  0 30400 0 02350        FSB INCRX          INITIALIZE CURRENT X        45000
01454  0 60100 0 02357        STO CRNTX                                      45000
01455  0 56000 0 02350        LDQ INCRX                                      45000
01456  0 26000 0 02351        FMP INCRY                                      45000
01457  0 60100 0 02375        STO TEMPA                                      45000
01460  0 24100 0 02354        FDP TARGA                                      45000
01461 -0 60000 0 02363        STO COEFF          PARAMETERS FOR              45000
01462  0 60000 0 02365        STZ PCZ            OPTIONAL DOSE               45000
01463  0 60000 0 02364        STZ PCNZ           CALCULATION                 45000
01464  0 53400 4 02346        LXA PCNDX,4                                    45000
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```
01465   0 60000 4 00000  CLRFC STZ **,4                    CLEAR COUNTS                45000
01466   2 00001 4 01465        TIX *-1,4,1                 IN HISTOGRAM                45000
01467   0 53400 4 02315        LXA FIVE,4                                              45000
01470   0 50000 4 02411  CLRM  CLA NEWM,4                  MOVE MOMENTS AND            45000
01471   0 60100 4 02404        STO OLDM,4                  CLEAR FOR NEXT SET          45000
01472   0 60000 4 02411        STZ NEWM,4                                              45000
01473   2 00001 4 01470        TIX CLRM,4,1                                            45000
01474  -0 53400 4 02344        LXD YNDX,4                                              45000
01475   0 50000 0 67027        CLA YZRO                                                45000
01476   0 02000 0 01500        TRA **+2                                                45000
01477   0 30000 0 02351        FAD INCRY                                               45000
01500   0 60100 4 00000  YTBLB STO **,4                    STORE Y TABLE               45000
01501   2 00001 4 01477        TIX *-2,4,1                                             45000
01502   0 56000 0 67032        LDQ SUMX                    COMPUTE M                   45000
01503   0 20000 0 67033        MPY SUMY                                                45000
01504  -0 60000 0 02375        STO TEMPA                                               45000
01505   0 50000 0 02375        CLA TEMPA                                               45000
01506   0 40000 0 02335        ADD FLOTR                                               45000
01507   0 30000 0 02335        FAD FLOTR                                               45000
01510   0 60100 0 02347        STO IJFLT                                               45000
01511   0 02000 0 01512  SUTBR TRA SUTN1
01512   0 07400 4 02114  SUTN1 TSX SSUT,4                                             45000
01513   0 02000 0 01531  SUTNA TRA TESTN
                         01514 SPAR  BSS 18                                          45000
01531   0 50000 0 67000  TESTN CLA N                                                 45000
01532   0 40200 0 02313        SUB ONE                                                 45000
01533   0 10000 0 01537        TZE TNA                                                 45000
01534   0 50000 0 02342        CLA NOP                                                 04502
01535   0 60100 0 01575        STO DPRTN                                               04502
01536   0 02000 0 01546        TRA GO                                                  45000
01537   0 53400 1 02313  TNA   LXA ONE,1                                             45000
01540   0 60000 1 00000  ZTBLE STZ **,1                   PLACE MUNITION
01541   0 60000 1 00000  ETBLE STZ **,1                   AT ZERO, ZERO
01542   0 50000 0 02340        CLA RELC                                                45000
01543   0 60100 0 01575        STO DPRTN                                               04502
01544   0 07400 4 70013        TSX XPRINT,4                                            45000
01545   0 02740 0 02727        PZE FORMN,0,FORMN+9                                     45000
01546   0 53400 1 67032  GO    LXA SUMX,1                                              45000
01547   0 02000 0 01550        TRA NEWX
01550  -0 63400 1 02343  NEWX  SXD XNDX,1                                            04502
01551   0 50000 0 02350        CLA INCRX                                               04502
01552   0 30000 0 02357        FAD CRNTX
01553   0 60100 0 02357        STO CRNTX                   STORE NEW X(I)              45000
01554  -0 53400 1 02344        LXD YNDX,1                                              45000
01555   0 60000 1 00000  DTBLA STZ **,1                   CLEAR DOSE CELLS            45000
01556   2 00001 1 01555        TIX *-1,1,1                                             45000
01557  -0 53400 1 02345        LXD KNDX,1                                              45000
01560  -0 53400 2 02344  STEP3 LXD YNDX,2                                             45000
01561   0 50000 2 00000  YTBLA CLA **,2                   GENERATE TABLE              45000
01562   0 30200 1 00000  ETBLA FSB **,1                   OF Y(J)-ETA(K)              45000
01563   0 60100 2 00000  YDIFA STO **,2                   (K CONSTANT, J RUNS)        45000
01564   2 00001 2 01561        TIX YTBLA,2,1                                           45000
01565  -0 53400 2 02344        LXD YNDX,2                                              45000
01566   0 50000 0 02357        CLA CRNTX                   EXIT WITH X(I)-ZETA(K)      45000
01567   0 30200 1 00000  ZTBLA FSB **,1                   IN ACCUMULATOR TO
01570  -0 12000 0 01572        THI **+2                    GET DOSE ALONG X(I)
01571   0 07400 4 02163        TSX DOSE,4                  DUE TO MUNITION K,          45000
01572   2 00001 1 01560        TIX STEP3,1,1               NEW MUNITION
01573   0 50000 0 67040        CLA PROPT                   TEST FOR DOSE PRINT         45000
01574  -0 10000 0 01750        TNZ DPRNT                                               04502
01575   0 76100 0 00000  DPRTN NOP                         TO FIXPT FOR 1 MUNITION     04502
01576  -0 53400 1 02344        LXD YNDX,1                                              04502
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01577  0 76100 0 00000  OPTPC NOP                                  OR TRA OPT4                    45000
01600  0 50000 1 00000  STEP4 CLA **,1                                                             45000
01601  0 10000 0 01606        TZE FADAZ                                                            04502
01602  0 07400 4 67106        TSX LOG,4                            COMPUTE P(C)                   45000
01603  0 60100 0 02375        STO TEMPA                                                           45000
01604  0 56000 0 02375        LDQ TEMPA                                                           45000
01605  0 26000 0 67024        FMP BZERO                                                           45000
01606  0 30000 0 67025  FADAZ FAD AZERO                                                          04502
01607 -0 76000 0 00004        LFM                                                                 45000
01610  0 07400 4 02762        TSX ERF+5,4
01611 -0 76000 0 00002        LFM                                                                 04502
01612  0 10000 0 01614        TZL DTBLD
01613  0 40200 0 02317        SUB MPTWO                                                           04502
01614  0 60100 1 00000  DTBLD STO **,1                                                           04502
01615 -0 30000 0 02355  STEP5 UFA FIXER                            SCORE IN HISTOGRAM             45000
01616 -0 73400 4 00000        PDX 0,4                                                             45000
01617 -3 00000 4 01621  FCA   TXL **2+4,**                         P(C) EXCEEDS 1                 45000
01620  0 07400 4 70026        TSX LRRDMP,4                                                        45000
01621  0 50000 4 00000  FCB   CLA **,4                            PLUS ADDRESS OF LOWEST         45000
01622  0 40000 0 02313        ADD ONE                             PROBABILITY COUNTER+           45000
01623  0 60100 4 00000  FCC   STO **,4                            GENERATE MOMENTS+              45000
01624  0 53400 4 02315  STEP6 LXA FIVE,4                                                         45000
01625  0 50000 1 00000  DTBLE CLA **,1                                                           45000
01626  0 10000 0 01642        TZL CYCL+1                                                          04502
01627  0 02000 0 01636        TRA DTBLF+1                                                         04502
01630  0 50000 0 02375  NOMT  CLA TEMPA
01631  0 40200 0 02321        SUB MAG
01632  0 12000 0 01634        TPL DTBLF-1
01633  0 02000 0 01641        TRA CYCL
01634  0 56000 0 02375        LDQ TEMPA                                                           45000
01635  0 26000 1 00000  DTBLF FMP **,1                                                           45000
01636  0 60100 0 02375        STO TEMPA                                                           45000
01637  0 30000 4 02411        FAD NEWM,4                                                          45000
01640  0 60100 4 02411        STO NEWM,4                                                          45000
01641  2 00001 4 01630  CYCL  TIX MOMT,4,1
01642  2 00001 1 01600        TIX STEP4,1,1                                                       45000
01643  0 50000 0 67040        CLA PROPT                                                           45000
01644 -0 10000 0 01763        TNZ PPRNT                           PRINT OPTION P(C)              45000
01645 -0 53400 1 02349  PPRTN LXD X1DX,1                                                         45000
01646  2 00001 1 01550        TIX NEWX,1,1                                                        45000
01647  0 53400 4 02315        LXA FIVE,4                                                          45000
01650  0 50000 4 02411        CLA NEWM,4                                                          45000
01651  0 24100 0 02347        FDP TOFLT                                                           45000
01652 -0 60000 4 02411        STO NEWM,4                                                          45000
01653  2 00001 4 01630        TIX NOMT,4,1                                                        45000
01654  0 50000 0 67040        CLA PROPT                                                           45000
01655 -0 10000 0 01767        TNZ PREM                            TO PRINT F(D),M(R)             45000
01656  0 53400 4 02315  FMRTN LXA FIVE,4                                                         45000
01657  0 50000 4 02404        CLA OLDR,4                                                          45000
01660  0 30200 4 02411        FSB NEWM,4                                                          45000
01661  0 76000 0 00003        SSP                                 TEST ARITHMETIC MEAN           45000
01662  0 20200 0 67047        FSB EPS                             THRESHOLD CRITERION+           45000
01663  0 12000 0 01700        TPL STEP7                                                           45000
01664  0 50000 0 67040        CLA PROPT                                                           45000
01665 -0 10000 0 01000        TNZ START                                                           45000
01666  0 07400 4 70007  OUTA  TSX OUTPUT,4                                                       45000
01667  0 00011 0 02412              FORMA+0+9                                                    45000
01670 -1 02561 0 02361        MON CUT+0+CUT                                                       45000
01671  0 07400 4 70007        TSX OUTPUT,4                                                        45000
01672  0 00011 0 02427              FORMB+0+9                                                    45000
01673 -1 00000 0 00000  FCD   MON **+0+**                         FREQUENCY COUNT                45000
01674  0 07400 4 70007        TSX OUTPUT,4                        AND MOMENTS PRINT              45000
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01675  0 00011 0 02433            FORMC,0,9                                    45000
01676 -1 02410 0 02404         MON NEWM-8,0,NEWM-1                             45000
01677  0 02000 0 01000         TRA START                                       45000
01700  0 50000 0 67036 STEP7   CLA ITRAT
01701  0 40200 0 02313         SUB ONE                                         45000
01702  0 60100 0 67036         STO ITRAT
01703 -0 10000 0 01741         TNZ NHANS                                       45000
01704  0 07400 4 70013         TSX XPRINT,4                                    45000
01705  0 02452 0 02445         PZE FORME,0,FORME+8                             45000
01706  0 07400 4 70007         TSX OUTPUT,4                                    45000
01707  0 00011 0 02440            FORMD,0,9                                    45000
01710 -1 02403 0 02377         MON OLDM-5,0,OLDM-1                             45000
01711  0 50000 0 67040         CLA PROPT                                       45000
01712  0 10000 0 01666         TZE OUTA                                        45000
01713  0 02000 0 01000         TRA START                                       45000
01714  0 50000 1 00000 OPT4    CLA **,1                   (DTABL)              45000
01715  0 40200 0 02323         SUB PT75                   OPTIONAL CASUALTY
01716  0 12000 0 01724         TPL *+6                    DETERMINATION        45000
01717  0 50000 0 02365         CLA PCZ                                         45000
01720  0 40000 0 02313         ADD ONE                                         45000
01721  0 60100 0 02365         STO PCZ                                         45000
01722  2 00001 1 01714         TIX OPT4,1,1                                    45000
01723  0 02000 0 01730         TRA XTEST                                       45000
01724  0 50000 0 02364         CLA PCNZ                                        45000
01725  0 40000 0 02313         ADD ONE                                         45000
01726  0 60100 0 02364         STO PCNZ                                        45000
01727  2 00001 1 01714         TIX OPT4,1,1                                    45000
01730 -0 53400 1 02343 XTEST    LXD XNDX,1                                     45000
01731  2 00001 1 01550         TIX NEWX,1,1                                    45000
01732  0 07400 4 70007         TSX OUTPUT,4                                    45000
01733  0 00011 0 02493            FORMF,0,9                                    45000
01734 -1 02365 0 02363         MON COEFF,0,PCZ
01735  0 50000 0 67036         CLA ITRAT
01736  0 40200 0 02313         SUB ONE                                         45000
01737  0 60100 0 67036         STO ITRAT
01740  0 10000 0 01000         TZE START                                       45000
01741  0 50000 0 67032 NHANS   CLA SUMX                                        45000
01742  0 40000 0 67034         ADD DELSX                                       45000
01743  0 60100 0 67032         STO SUMX                                        45000
01744  0 50000 0 67033         CLA SUMY                                        45000
01745  0 40000 0 67035         ADD DELSY                                       45000
01746  0 60100 0 67033         STO SUMY                                        45000
01747  0 02000 0 01400         TRA RENTR                                       45000
                               PRINT OPTIONS                                   45000
01750  0 50200 0 02343 DPRNT   CLS XNDX                   PRINT DOSE           45000
01751  0 77100 0 00022         ARS 18                                          45000
01752  0 40000 0 67032         ADD SUMX                                        45000
01753  0 60100 0 02366         STO NETX                                        45000
01754  0 07400 4 70007         TSX OUTPUT,4                                    45000
01755  0 00011 0 02467            FORMG,0,9                                    45000
01756 -1 02366 0 02366         MON NETX,0,NETX                                 45000
01757  0 07400 4 70007         TSX OUTPUT,4                                    45000
01760  0 00011 0 02474            FORMH,0,9                                    45000
01761 -1 00000 0 00000 DPRTA    MON **,0,**                (DTABL-J),(DTABL-1)  45000
01762  0 02000 0 01575         TRA DPRTN                                       45000
01763  0 07400 4 70007 PPRNT   TSX OUTPUT,4               PRINT PSUBC          45000
01764  0 00011 0 02474            FORMH,0,9                                    45000
01765 -1 00000 0 00000 PPRTA    MON **,0,**                (DTABL-J),(DTABL-1)  45000
01766  0 02000 0 01645         TRA PPRTN                                       45000
01767  0 07400 4 70007 PREM    TSX OUTPUT,4               PRINT FREQUENCY      45000
01770  0 00011 0 02412            FORMA,0,9               COUNT AND MOMENTS    45000
01771 -1 02361 0 02361         MON CUT,0,CUT                                   45000
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01772  0 07400 4 70007          TSX OUTPUT,4                                    45000
01773  0 00011 0 02427          FORMB,0,9                                       45000
01774 -1 00000 0 00000  FGE      MON **,0,**                  COUNT              45000
01775  0 07400 4 70007          TSX OUTPUT,4
01776  0 00011 0 02433          FORMC,0,9                                       45000
01777 -1 02410 0 02404          MON NEWM-B,0,NEWM-1                             04502
02000  0 02000 0 01656          TRA FMRTN                                       45000
                                PRINT IN FIXED POINT                            04502
02001 -0 50000 0 01555  FIXPT   CAL DTBLA                                       04502
02002  0 62100 0 02085          STA FIXPG                                       04502
02003  0 62100 0 02063          STA FIXPH                                       04502
02004  0 40200 0 67033          SUB SUMY                                        04502
02005  0 62100 0 02006          STA FIXPA                                       04502
02006 -0 50000 0 00000  FIXPA   CAL **                       GET SCALE FACTOR   04502
02007  0 10000 0 02077          TZE FIXPK+1                                     04502
02010  0 12000 0 02012          TPL *+2                                         04502
02011  0 07400 4 70024          TSX ENDJOB,4                                    04502
02012  0 60100 0 02375          STO TEMPA                                       04502
02013  0 50000 0 02341          CLA RELD                                        04502
02014  0 60100 0 01575          STO DPRTN                                       04502
02015  0 50000 0 01761          CLA DPRTA                                       04502
02016  0 60100 0 02076          STO FIXPK                                       04502
02017  0 50000 0 02375          CLA TEMPA                                       04502
02020  0 34000 0 02331          CAS LIMIT                                       04502
02021  0 02000 0 02036          TRA FIXPC                                       04502
02022  0 76100 0 00000          NOP                                             04502
02023  0 50000 0 02322          CLA ONEF                                        04502
02024  0 60100 0 02371          STO MPYER                                       04502
02025  0 56000 0 02375  FIXPB   LDQ TEMPA                                       04502
02026  0 26000 0 02326          FMP TENF                                        04502
02027  0 60100 0 02375          STO TEMPA                                       04502
02030  0 40200 0 02331          SUB LIMIT                                       04502
02031  0 12000 0 02051          TPL FIXPE
02032  0 56000 0 02371          LDQ MPYER                                       04502
02033  0 26000 0 02326          FMP TENF                                        04502
02034  0 60100 0 02371          STO MPYER                                       04502
02035  0 02000 0 02025          TRA FIXPB                                       04502
02036  0 50000 0 02320  FIXPC   CLA TENTH                                       04502
02037  0 60100 0 02371          STO MPYER                                       04502
02040  0 56000 0 02375  FIXPD   LDQ TEMPA                                       04502
02041  0 26000 0 02320          FMP TENTH                                       04502
02042  0 60100 0 02375          STO TEMPA                                       04502
02043  0 40200 0 02331          SUB LIMIT                                       04502
02044 -0 12000 0 02051          TMI FIXPE                                       04502
02045  0 56000 0 02371          LDQ MPYER                                       04502
02046  0 26000 0 02320          FMP TENTH                                       04502
02047  0 60100 0 02371          STO MPYER                                       04502
02050  0 02000 0 02040          TRA FIXPD                                       04502
02051  0 07400 4 70007  FIXPE   TSX OUTPUT,4                 PRINT SCALE FACTOR 04502
02052  0 00011 0 02741          FORMO,0,9                                       04502
02053 -1 02371 0 02371          MON MPYER,0,MPYER                               04502
02054 -0 53400 1 02344  FIXPF   LXD YNDX,1                                      04502
02055  0 56000 1 00000  FIXPG   LDQ **,1                                       04502
02056  0 26000 0 02371          FMP MPYER                  SCALE TO POWER OF  04502
02057 -0 30000 0 02335          UFA FLOTR                  TEN NEXT BELOW     04502
02060 -0 77300 0 00010          RQL 8                      2**17 AND FIX
02061  0 76000 0 00010          RND
02062 -0 32000 0 02332          ANA MASKA
02063  0 60100 1 00000  FIXPH   STO **,1                                       04502
02064  2 00001 1 02059          TIX FIXPG,1,1                                   04502
02065  0 50200 0 02343          CLS XNDX                                        04502
02066  0 77100 0 00022          ARS 18                                          04502
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```
02067  0 40000 0 67032          ADD  SUMX                                        04502
02070  0 60100 0 02366          STO  NETX                                        04502
02071  0 07400 4 70007          TSX  OUTPUT,4                                    04502
02072  0 00011 0 02467               FORMG,0,9                                   04502
02073 -1 02366 0 02366          MON  NETX,0,NETX                                 04502
02074  0 07400 4 70007          TSX  OUTPUT,4                                    04502
02075  0 00011 0 02751               FORMP,0,9                                   04502
02076 -1 00000 0 00000  FIXPK   MON  **,0,**                                     04502
02077 -0 53400 1 02343          LXD  XNDX,1                                      04502
02100  2 00001 1 01550          TIX  NEWX,1,1                                    04502
02101  0 02000 0 01000          TRA  START                                       04502
                                BREATHING FUNCTION                              04502
02102  0 56000 0 67022  BRFA   LDQ  CZERO                                       04502
02103  0 26000 0 67021          FMP  T                                           04502
02104  0 60100 0 02375          STO  TEMPA                                       04502
02105  0 56000 0 67021          LDQ  T                                           04502
02106  0 26000 0 67021          FMP  T                                           04502
02107  0 60100 0 02376          STO  TEMPB                                       04502
02110  0 56000 0 02376          LDQ  TEMPB                                       04502
02111  0 26000 0 67023          FMP  CONE                                        04502
02112  0 30000 0 02375          FAD  TEMPA                                       04502
02113  0 02000 4 00001          TRA  1,4                                         04502
                                TRANSFER PARAMETERS NEEDED BY                   45000
                                SUTTON EQUATION SUBROUTINE                      45000
02114 -0 63400 4 02136  SSUT    SXD  SAVIV,4                                     45000
02115  0 50000 4 00002          CLA  2,4                                         45000
02116  0 62100 0 02272          STA  RUNY                                        45000
02117  0 62100 0 02274          STA  RUNY+2                                      45000
02120  0 50000 4 00003          CLA  3,4                                         45000
02121  0 62100 0 02305          STA  SUMD                                        45000
02122  0 62100 0 02306          STA  SUMD+1                                      45000
02123  1 77760 4 02124          TXI  *+1,4,-16                                   45000
02124 -0 75400 4 00000          PXD  0,4                                         45000
02125  0 76000 0 00006          COM                                              45000
02126  0 77100 0 00022          ARS  18                                          45000
02127  0 62100 0 02131          STA  *+2                                         45000
02130  0 53400 4 02136          LXA  SAVIV,4                                     45000
02131  0 50000 4 00000          CLA  **,4                                        45000
02132  0 60100 4 02152          STO  BT+1,4                                      45000
02133  2 00001 4 02131          TIX  *-2,4,1                                     45000
02134 -0 53400 4 02136          LXD  SAVIV,4                                     45000
02135  0 02000 4 00001          TRA  1,4                                         45000
02136  0 00000 0 00013  SAVIV  HTR  11,0,0
                                SUTTON EQUATION PARAMETERS                      45000
A  02137  0 00000 0 00000  SBETA HTR                          BETA              45000
A  02140  0 00000 0 00000  ALFXU HTR              ALF(X)(U**BETA)
A  02141  0 00000 0 00000  ALFZU HTR              ALF(Z)(U**BETA)-(ALF(X)(U**BETA)
A  02142  0 00000 0 00000  ALFYU HTR              ALF(Y)(U**BETA)-ALF(Z)(U**BLTA)
A  02143  0 00000 0 00000  UOVKY HTR                          -(U**BETA)/K(Y)   45000
A  02144  0 00000 0 00000  PREFX HTR                          CONSTANT MULTIPLIER 45000
A  02145  0 00000 0 00000  UOVKX HTR                          (U**BETA)/K(X)    45000
A  02146  0 00000 0 00000  UT     HTR                         U*T               45000
A  02147  0 00000 0 00000  AYL    HTR                         A                 45000
A  02150  0 00000 0 00000  UOVRB HTR                          U/U               45000
A  02151  0 00000 0 00000  BT     HTR                         U*T               45000
                                SUTTON EQUATION VARIABLES                       45000
A  02152  0 00000 0 00000  XDIFF HTR                          X(I)-ZETA(K)      45000
A  02153  0 00000 0 00000  ERFF   HTR                         ERF SORT,LTG.     45000
A  02154  0 00000 0 00000  SQRFA HTR                         DEXTER RADICAND   45000
A  02155  0 00000 0 00000  SQRFB HTR                         SINISTER RADICAND 45000
A  02156  0 00000 0 00000  EXPF   HTR                         EXPONENT FACTOR   45000
A  02157  0 00000 0 00000  PART   HTR                         Y-INDEPENDENT PARTS 45000
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A  02160  0 00000 0 00000  ERFB  HTR                          RIGHT HAND ERF                  45000
A  02161  0 00000 0 00000  RETNX HTR                          SAVE INDEX 4                    45000
A  02162  0 00000 0 00000  STEMP HTR                          UTILITY CELL                    45000
                           SUTTON EQUATION SOLUTION FOR ALL Y(I)                              45000
                           FOR A GIVEN X(I), K, TSX DOSE,4 WITH
                           X(I)-ZETA(K) IN ACC AND Y(J)-ETA(K)TABULATED.                      45000
                           REGISTERS ONE AND TWO ARE SET FOR USE
           02163 -0 61400 4 02161  DOSE  SXD RETNX,4           X MINUS ZETA IN ACC.            45000
           02164  0 60100 0 02152        STO XDIFF            REGS 1,2 FUNCTIONAL             45000
           02165  0 10000 0 02173        TZE DOSE+8
           02166  0 07400 4 67106        TSX LOG,4                                            45000
           02167  0 60100 0 02162        STO STEMP                                            45000
           02170  0 56000 0 02162        LDQ STEMP                                            45000
           02171  0 26000 0 02137        FMP SBETA                                            45000
           02172  0 07400 4 67101        TSX EXP,4                                            45000
           02173  0 30000 0 02140        FAD ALFXU                                            45000
           02174  0 60100 0 02153        STO ERFF             TERM FOR ERF SORT               45000
           02175  0 30000 0 02141        FAD ALFZU                                            45000
           02176  0 60100 0 02154        STO SQRFA                                            45000
           02177  0 30000 0 02142        FAD ALFYU                                            45000
           02200  0 60100 0 02155        STO SQRFB            DERIVE FACTOR FOR               45000
           02201  0 24100 0 02143        FDP UOVKY            RIGHT HAND EXP.                 45000
           02202 -0 60000 0 02156        STQ EXPF                                             45000
           02203  0 56000 0 02154        LDQ SQRFA                                            45000
           02204  0 26000 0 02155        FMP SQRFB                                            45000
           02205  0 07400 4 67107        TSX SQRT,4           GET SQUARE ROOT                 45000
           02206  0 24100 0 02144        FDP PREFX            BEGIN LEFT BRACE                45000
           02207 -0 60000 0 02157        STQ PART                                             45000
           02210  0 50000 0 02145        CLA UOVKX                                            45000
           02211  0 24100 0 02153        FDP ERFF                                             45000
           02212 -0 60000 0 02162        STQ STEMP                                            !
           02213  0 50000 0 02162        CLA STEMP                                            45000
           02214  0 07400 4 67107        TSX SQRT,4                                           45000
           02215  0 60100 0 02153        STO ERFF                                             45000
           02216  0 56000 0 02153        LDQ ERFF                                             45000
           02217  0 26000 0 02152        FMP XDIFF                                            45000
           02220 -0 76000 0 00004        LFM
           02221  0 40200 0 02325        SUB ERFT
           02222 -0 12000 0 02225        TMI *+3
           02223  0 50000 0 02322        CLA ONEF
           02224  0 02000 0 02227        TRA *+3
           02225  0 40000 0 02325        ADD ERFT
           02226  0 07400 4 02755        TSX ERF,4                                            45000
           02227  0 60100 0 02160        STO ERFB                                             45000
           02230  0 50000 0 02146        CLA UT                                               45000
           02231  0 30200 0 02152        FSB XDIFF                                            45000
           02232  0 60100 0 02162        STO STEMP                                            45000
           02233  0 56000 0 02162        LDQ STEMP                                            45000
           02234  0 26000 0 02153        FMP ERFF                                             45000
           02235  0 76000 0 00003        SSP                                                  !
           02236  0 40200 0 02325        SUB ERFT
           02237 -0 12000 0 02242        TMI *+3
           02240  0 50000 0 02322        CLA ONEF
           02241  0 02000 0 02244        TRA *+3
           02242  0 40000 0 02325        ADD ERFT
           02243  0 07400 4 02755        TSX ERF,4                                            45000
           02244 -0 76000 0 00002        LFM
           02245  0 30000 0 02160        FAD ERFB                                             45000
           02246  0 24100 0 02157        FDP PART                                             45000
           02247 -0 60000 0 02157        STQ PART                                             45000
           02250  0 50000 0 02147        CLA AYE                                              45000
           02251  0 10000 0 02272        TZE RUNY                                             45000
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```
02252  0 50000 0 02152          CLA XDIFF          DERIVE LEFT-HAND          45000
02253  0 24100 0 02150          FDP UOVRB          EXPONENTIAL               45000
02254 -0 60000 0 02162          STO STEMP                                    45000
02255  0 50000 0 02162          CLA STEMP                                    45000
02256  0 30200 0 02151          FSB BT                                       45000
02257  0 12000 0 02272          TPL RUNY                                     45000
02260  0 07400 4 67101          TSX EXP,4
02261  0 60100 0 02162          STO STEMP
02262  0 56000 0 02162          LDQ STEMP
02263  0 26000 0 02147          FMP AYE
02264  0 76000 0 00002          CHS                                          45000
02265  0 30000 0 02322          FAD ONEF                                     45000
02266  0 60100 0 02162          STO STEMP
02267  0 56000 0 02162          LDQ STEMP          Y-INDEPENDENT PART        45000
02270  0 26000 0 02157          FMP PART           OF EQUATION STORED,       45000
02271  0 60100 0 02157          STO PART           TIME ABOUT .0215 SEC.     45000
02272  0 50000 2 00000  RUNY    CLA **,2                                     45000
02273  0 24100 0 02156          FDP EXPF
02274  0 26000 2 00000          FMP **,2           COMPUTE DOSAGE
02275  0 34000 0 02330          CAS SXTYM          AT EACH Y(J) FOR THIS
02276  0 76100 0 00000          NOP                MUNITION AND ADD
02277  0 02000 0 02301          TRA *+2            TO TOTAL, TIME FOR
02300  0 02000 0 02307          TRA SUMD+2         EACH Y ABOUT .0034.
02301  0 07400 4 67101          TSX EXP,4
02302  0 60100 0 02162          STO STEMP
02303  0 56000 0 02162          LDQ STEMP
02304  0 26000 0 02157          FMP PART
02305  0 30000 2 00000  SUMD    FAD **,2
02306  0 60100 2 00000          STO **,2
02307  2 00001 2 02272          TIX RUNY,2,1                                 45000
02310 -0 53400 4 02161          LXD RETNX,4        TO GET NEXT K OR X        45000
02311  0 02000 4 00001          TRA 1,4                                      45000
                                CONSTANTS AND RELADS                         45000
02312 +000000000000     ZERO    DEC 0                                        45000
02313 +000000000001     ONE     DEC 1                                        45000
02314 +000000000004     FOUR    DEC 4                                        45000
02315 +000000000005     FIVE    DEC 5                                        45000
02316 +000000000011     NINE    DEC 9                                        45000
02317 +001000000000     MP1WO   DEC 1B8                                      45000
02320 +175631463146     TENTH   DEC 0.1                                      04502
02321 +110560736521     MAG     DEC 1.0E-17
02322 +201400000000     ONEF    DEC 1.0                                      45000
02323 +200600000000     PT75    DEC .75                                      45000
02324 +202622077324     PI      DEC 3.14159265                               45000
02325 +202763146316     EXPI    DEC 3.9                                      04502
02326 +204500000000     TENF    DEC 10.0                                     45000
02327 +204600000000     TWELV   DEC 12.0
02330 -206740000000     SXTYM   DEC -60.0                                    04502
02331 +221777777777     LIMIT   OCT 221777777777                             04502
02332 +000000377777     MASKA   OCT 000000377777                             45000
02333 +000000077777      MASK   OCT 000000077777                             45000
02334 +343277244615     VPOWR   OCT 343277244615                             45000
02335 +233000000000     FLOTH   OCT 233000000000                             45000
02336  2 00000 0 00000  EXPO    TIX 0,0,0                                    45000
02337  0 02000 0 01714  RELA    TRA OPT4                                     04502
02340  0 02000 0 02001  RELC    TRA FIXPT                                    04502
02341  0 02000 0 02054  RELD    TRA FIXPF
02342  0 76100 0 00000  NOP     NOP
                                PROGRAM-GENERATED PARAMETERS                 45000
02343  0 00000 0 00000  XNOX                                                 45000
02344  0 00000 0 00000  YNOX                                                 45000
02345  0 00000 0 00000  KNOX                                                 45000
```

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BESYS 2, SAP 3-7 ASSEMBLY OF ANALYTIC DISSEMINATION FUNCTION PROGRAM    PAGE 17
                                                                             45000
02346  0 00000 0 00000  FCNDX                           M IN FLOATING        45000
02347  0 00000 0 00000  IJFLT                           DELTA X              45000
02350  0 00000 0 00000  INCRX                           DELTA Y              45000
02351  0 00000 0 00000  INCRY                           DIMENSIONS OF        45000
02352  0 00000 0 00000  XSPAN                           IMPACT AREA.         45000
02353  0 00000 0 00000  YSPAN                           AREA OF TARGET       45000
02354  0 00000 0 00000  TARGA                                                45000
02355  0 00000 0 00000  FIXER                                                45000
02356  0 00000 0 00000  ADINC
02357  0 00000 0 00000  CRNTX                                                45000
02360  0 00000 0 00000 CRNTAD                           HISTOGRAM INTERVAL   45000
02361  0 00000 0 00000  CUT                             U**BETA              45000
02362  0 00000 0 00000  UBETA                           D(X)*D(Y)/T(A)       45000
02363  0 00000 0 00000  COEFF                           (COEFF,PCZ,AND PCNZ  45000
02364  0 00000 0 00000  PCNZ                            ORDERED FOR PRINT)   45000
02365  0 00000 0 00000  PCZ                             X SUBSCRIPT FOR PRINT 45000
02366  0 00000 0 00000  NETX                            CURRENT RANDOM NO.   45000
02367  0 00000 0 00000  NEWRN                           BREATHING FUNCTION   45000
02370  0 00000 0 00000  BSUBT                           SCALE FACTOR         04502
02371  0 00000 0 00000  MPYER                           HISTOGRAM FRACTIONATION
02372 +000000000004     FCPWR DEC 4
02373  0 00000 0 00000  RXSUM
02374  0 00000 0 00000  RYSUM
02375  0 00000 0 00000  TEMPA                                                45000
02376  0 00000 0 00000  TEMPB                                                45000
                 02404  OLDM  BES 5                                          45000
                 02411  NEWM  BES 5                                          45000
02411  016060606060     FORM  BCD 11                                         45000
02412  740600300060     FORMA BCD 616000 DISTRIBUTION OF P(C), ORDERED       45000
02413  243162635131
02414  226463314645
02415  604626604774
02416  233473604651
02417  242551252460
02420  464525606346          BCD ZONE TO ZERO, AT INTERVALS OF1P1E13.5)
02421  607125514673
02422  602163603145
02423  632551652143
02424  626046260147
02425  012501033305
02426  346060606060
02427  740230006001     FORMB BCD 41[illegible] 16.7/(2[illegible] 16.7))    45000
02430  06430761740[illegible]
02431  306060010645
02432  073434606060
02433  740104300060     FORMC BCD 5(1400 NEW MOMENTS-1P5E14.5)               45000
02434  452566604446
02435  442545636240
02436  014705250104
02437  330534606060
02440  740104300060     FORMD BCD 5(1400 OLD MOMENTS-1P5E14.5)               45000
02441  464324604446
02442  442545636240
02443  014705250104
02444  330534606060
02445  0060[illegible]1316     FORME BCD 60 ARITHMETIC MEAN CRITERION NOT MET 45000
02446  3044[illegible]
02447  6044[illegible]
02450  [illegible]
02451  [illegible]
02452  636064[illegible]
02453  740201[illegible]0060     FORMF BCD 612[illegible] NUMBER TIMES [illegible]   45000
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02454  456444222551
02455  606331442562
02456  604762642223
02457  130147012501
02460  023304734507
02461  610206300060          BCD 6?26HO NUMBER TIMES PSUBC= ZERON?)                     45000
02462  456444222551
02463  606331442562
02464  604762642223
02465  136071255146
02466  450734606060
02467  740105300060       FORMG BCD 5(15HO DOSE ALONG X(N3,I6))                         45000
02470  244662256021
02471  434643276057
02472  744303730130
02473  342460606060
02474  740230000001       FORMH BCD 5(2HO 1P9E12.4/(20  9E12.4))                        45000
02475  471123010233
02476  046174022060
02477  601125010233
02500  043434606060
02501  740111300060       FORMI BCD 7(19HO NUMBER MONITIONS=N3,9H  OPTION=N1,7H         45000
02502  456444222551
02503  604464453163
02504  314645621345
02505  037311306060
02506  464763314645
02507  404301720730
02510  600021740034          BCD 6  A(0)=1P1E11.3,7H  A(1)=E11.3,7H  B                  45000
02511  130147012501
02512  013303720730
02513  606021740134
02514  132201013503
02515  730730606072
02516  7400341[illegible]01          BCD 5(0)=E11.3,?  [illegible](1)=E11.3?H  [illegible]E11.3           45000
02517  013303730730
02520  606022760124
02521  122201012307
02522  610430606021
02523  [illegible]
02524  730420[illegible]06022          BCD 6,4  [illegible]=E11.3/[illegible]  ALPHA(X) E11.3,11H              45000
02525  132201013507
02526  610101306060
02527  214347702174
02530  6734[illegible]0101
02531  3?037301012C
02532  600621434720          BCD 6  ALPHA(Y) E11.3,11H  ALPHA(Z)=E11.3                  45000
02533  21747034[illegible]
02534  010133037301
02535  0[illegible]
02536  4730[illegible]17471[illegible]
02537  132501013[illegible]
02540  6107305060[illegible]          BCD 6776  K(X)=E11.3,7H  K(Y)=E11.3,6H                     45000
02541  7467[illegible]
02542  01[illegible]
02543  [illegible]
02544  1[illegible]
02545  [illegible]
02546  [illegible]          BCD 6E[illegible]  [illegible]  K(Z)=E11.3?H  [illegible]ETA                 45000
02547  [illegible]
0255[illegible]  [illegible]
025[illegible]  [illegible]
```

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BESYS 2, SAP 3-7 ASSEMBLY OF ANALYTIC DISSEMINATION FUNCTION PROGRAM PAGE 15

```
02552  013303610730
02553  606022256321
02554  132501003302          BCD 6=E10.2,4H  U=E11.3,7H  Q(0)=E14.6/4H
02555  730430606064
02556  132501013303
02557  730730606050
02560  740034132501
02561  043306610430
02562  606063132501          BCD 8  T=E11.3,7H  G(0)=E12.4,6H C(1)=E12.4/13H  SMAL
02563  013303730730
02564  606023740034
02565  132501023304
02566  730630602374
02567  013413250102
02570  330461010330
02571  606062442143
02572  436022740034          BCD 6L B(0)=E11.3,15H  SMALL A(0)-5=E11.3                45000
02573  132501013303
02574  730105306060
02575  624421434360
02576  217400344005
02577  132501013303
02600  610730606067          BCD 6/7H  X(0)=E11.3,7H  Y(0)=E11.3,9H  X                45000
02601  740034132501
02602  013303730730
02603  606070740034
02604  132501013303
02605  731130606067
02606  744421673413          BCD 6(MAX)=E11.3,9H  Y(MAX)=E11.3/10H  TO                45000
02607  250101330373
02610  113060607074
02611  442167341325
02612  010133026101
02613  003060606346
02614  632143606713          BCD 6TAL X=N4,10H  TOTAL Y=N4,9H  INCR X=                45000
02615  450473010030
02616  606063466321
02617  436070134504
02620  731130606031
02621  452351606713
02622  450373113060          BCD 7N3,9H  INCR Y=N3,22H  NO. INCREMENTATIONS=          45000
02623  603145235160
02624  701345027302
02625  023060604546
02626  336031432351
02627  254425456321
02630  633146456213
02631  450261010030          BCD 7N2/10H  EPSILON=E11.3,15H  PRINT OPTION=N2          45000
02632  606025476231
02633  434645132501
02634  013303730105
02635  306060475131
02636  456360464763
02637  314645134502
02640  730205306060          BCD 9,25H  STARTING RANDOM NUMBER=1013)                  45000
02641  626321516331
02642  452760512145
02643  244644604564
02644  442225511301
02645  460103346060
02646  606060606060
02647  606060606060
```

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02650  606060606060
02651  606060606060          BCD 9
02652  606060606060
02653  606060606060
02654  606060606060
02655  606060606060
02656  606060606060
02657  606060606060
02660  606060606060
02661  606060606060
02662  006044644531    FORMJ BCD 40 MUNITIONS LOCATED AT-
02663  633146456260
02664  434623216325
02665  246021634060
02666  740230606001    FORMK BCD 9(2H  1P1E11.3,1E11.3,E13.3,E11.3,E13.3,E11.3)                45000
02667  470125010133
02670  037301250101
02671  330373250103
02672  330373250101
02673  330373250103
02674  330373250101
02675  330346606060
02676  606060606060
02677  740211300060    FORML BCD 9(29H0 LAST RANDOM NUMBER USED WAS1013)                       45000
02700  432162636051
02701  214524464460
02702  456444222551
02703  606462252460
02704  662162014601
02705  033460606060
02706  606060606060
02707  606060606060
02710  740106300060    FORMM BCD 6(16H0 THIS RUN USES N3,17H VALUES OF
02711  633031626051
02712  644560646225
02713  626045037301
02714  073060652143
02715  642562604626
02716  606760214524          BCD 9 X AND N3,12H VALUES OF Y)
02717  604503730102
02720  306065214364
02721  256260462660
02722  703460606060
02723  606060606060
02724  606060606060
02725  606060606060
02726  606060606060
02727  006062472523    FORMN BCD 50 SPECIAL ONE-MUNITION RUN FOR                               04502
02730  312143604645
02731  254044644531
02732  633146456051
02733  644560264651
02734  603145476463          BCD 5 INPUT TO OVERLAY PROGRAM                                   04502
02735  606346604665
02736  255143217060
02737  475146275121
02740  446060606060
02741  740302300060    FORMO BCD 6(32H0 DOSES HAVE BEEN MULTIPLIED BY                          04502
02742  244662256260
02743  302165256022
02744  252545604464
02745  436331474331
```

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02746  252460227060
02747  014701251033                BCD 21P1E8.1)
02750  013460606060
02751  740230006011        FORMP BCD 4(2H0 9N7/(2H  9N7))                              04502
02752  450761740230
02753  606011450734
02754  346060606060
                                  ERF SUBROUTINE                                       45000
02755  0 76000 0 00003  ERF    SSP                   ERROR FUNCTION ENTRY              ERF20013
02756  0 60100 0 03052         STO COMMON+1                                            ERF20014
02757  0 50000 0 03034         CLA ERF+47                                              ERF20015
02760  0 60100 0 03024         STO ERF+39                                              ERF20016
02761  0 02000 0 02776         TRA ERF+17                                              ERF20017
02762  0 12000 0 02770         TPL ERF+11            NORMAL FREQUENCY FUNCTION ENTRY   ERF20018
02763  0 76000 0 00003         SSP                                                     ERF20019
02764  0 60100 0 03052         STO COMMON+1                                            ERF20020
02765  0 50000 0 03025         CLA ERF+40                                              ERF20021
02766  0 60100 0 03024         STO ERF+39                                              ERF20022
02767  0 02000 0 02773         TRA ERF+14                                              ERF20023
02770  0 60100 0 03052         STO COMMON+1                                            ERF20024
02771  0 50000 0 03026         CLA ERF+41                                              ERF20025
02772  0 60100 0 03024         STO ERF+39                                              ERF20026
02773  0 56000 0 03052         LDQ COMMON+1                                            ERF20027
02774  0 26000 0 03047         FMP ERF+58                                              ERF20028
02775  0 60100 0 03052         STO COMMON+1                                            ERF20029
02776 -0 63400 4 03025         SXD ERF+40,4                                            ERF20030
02777  0 14000 0 03000         TOV ERF+19                                              ERF20031
03000 -0 53400 4 03026         LXD ERF+41,4                                            ERF20032
03001  0 60000 0 03051         STZ COMMON                                              ERF20033
03002  0 56000 0 03051         LDQ COMMON                                              ERF20034
03003  0 26000 0 03052         FMP COMMON+1                                            ERF20035
03004  0 30000 4 03046         FAD ERF+57,4                                            ERF20036
03005  0 60100 0 03051         STO COMMON                                              ERF20037
03006  2 00001 4 03002         TIX ERF+21,4,1                                          ERF20038
03007  0 14000 0 03035         TOV ERF+48                                              ERF20039
03010 -0 53400 4 03050         LXD ERF+59,4                                            ERF20040
03011  0 56000 0 03051         LDQ COMMON                                              ERF20041
03012  0 26000 0 03051         FMP COMMON                                              ERF20042
03013  0 60100 0 03051         STO COMMON                                              ERF20043
03014  2 00002 4 03011         TIX ERF+28,4,2                                          ERF20044
03015  0 14000 0 03035         TOV ERF+48                                              ERF20045
03016  0 50000 0 03045         CLA ERF+56                                              ERF20046
03017  0 24000 0 03051         FDH COMMON                                              ERF20047
03020 -0 60000 0 03051         STQ COMMON                                              ERF20048
03021  0 50000 0 03045         CLA ERF+56                                              ERF20049
03022  0 30200 0 03051         FSB COMMON                                              ERF20050
03023 -0 53400 4 03025         LXD ERF+40,4                                            ERF20051
03024  0 76100 0 00000         NOP                                                     ERF20052
03025  1 00000 0 03027         TXI ERF+42,,0                                           ERF20053
03026  1 00007 0 03030         TXI ERF+43,,7                                           ERF20054
03027  0 76000 0 00002         CHS                                                     ERF20055
03030  0 30000 0 03045         FAD ERF+56                                              ERF20056
03031  0 60100 0 03051         STO COMMON                                              ERF20057
03032  0 56000 0 03051         LDQ COMMON                                              ERF20058
03033  0 26000 0 03046         FMP ERF+57                                              ERF20059
03034  0 02000 4 00001         TRA 1,4                                                 ERF20060
03035  0 50000 0 03045         CLA ERF+56                                              ERF20061
03036  0 02000 0 03023         TRA ERF+38                                              ERF20062
03037 +1625[illegible]75471          DEC .000043003[illegible],.000276567[illegible],.0001[illegible]014[illegible],.00[illegible]705[illegible]   ERF20063
03040 +165442000705
03041 +164476630071
03042 +172457615506
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BESYS 2, SAP 3-7 ASSEMBLY OF ANALYTIC DISSEMINATION FUNCTION PROGRAM    PAGE 18
                                                                                ERF20064
03043 +174532277472             DEC .0422820123,.0705230784,1..5,.70710678
03044 +175440671472
03045 +201400000000
03046 +200400000000
03047 +200552023631                                                             ERF20065
03050  0 00010 0 00000          HTR 0,0,8
                       03051 COMMON BSS 2                                       45000
                                  INPUT PARAMETERS                              45000
                       67000      ORG 28160                                     45000
67000  0 00000 0 00000  N                        NUMBER MUNITIONS
67001  0 00000 0 00000  CHOOZ                   0=READ, 1 OR 2= GENERATE
67002  0 00000 0 00000  AZRO                    AZRO THROUGH BONE               45000
67003  0 00000 0 00000  AONE                    ARE COORDINATES                 45000
67004  0 00000 0 00000  BZRO                    USED TO DEFINE                  45000
67005  0 00000 0 00000  BONE                   TARGET CONFIGURATION            45000
67006  0 00000 0 00000  A                      A                               45000
67007  0 00000 0 00000  B                      B                               45000
67010  0 00000 0 00000  ALFX                   ALPHA(X)                        45000
67011  0 00000 0 00000  ALFY                   ALPHA(Y)                        45000
67012  0 00000 0 00000  ALFZ                   ALPHA(Z)                        45000
67013  0 00000 0 00000  KX                     K(X)                            45000
67014  0 00000 0 00000  KY                     K(Y)                            45000
67015  0 00000 0 00000  LMKZ                   LAMBDA/SQRT(K(Z))               45000
67016  0 00000 0 00000  BETA                   BETA                            45000
67017  0 00000 0 00000  U                      U                               45000
67020  0 00000 0 00000  QZRO                   Q(0)                            45000
67021  0 00000 0 00000  T                      TIME                            45000
67022  0 00000 0 00000  CZERO                  PARAMETERS FOR                  04502
67023  0 00000 0 00000  CONE                   BREATHING FUNCTION              04502
67024  0 00000 0 00000  BZERO                  (0) FOR P(C)COMP.               45000
67025  0 00000 0 00000  AZROB                  A(0)=5 FOR P(C)COMP.            45000
67026  0 00000 0 00000  XZRO                   X(0)                            45000
67027  0 00000 0 00000  YZRO                   Y(0)                            45000
67030  0 00000 0 00000  XMAX                   X(MAX)                          45000
67031  0 00000 0 00000  YMAX                   Y(MAX)                          45000
67032  0 00000 0 00000  SUMX                   TOTAL X POINTS                  45000
67033  0 00000 0 00000  SUMY                   TOTAL Y POINTS                  45000
67034  0 00000 0 00000  DELSX                  INCREMENT TO TOTAL X            45000
67035  0 00000 0 00000  DELSY                  INCREMENT TO TOTAL Y            45000
67036  0 00000 0 00000  ITRAT                  NUMBER ITERATIONS               45000
67037  0 00000 0 00000  EPS                    EPSILON                         45000
67040  0 00000 0 00000  PROPT                  0=NO PRINT OPTIONS              45000
67041  0 00000 0 00000  RANDM                  STARTING RANDOM NO.             45000
                       67100 PACKG  EQU 28224                                   45000
                       67101 EXP    EQU PACKG+1                                 45000
                       67106 LOG    EQU PACKG+6                                 45000
                       67107 SQRT   EQU PACKG+7                                 45000
                       01000        END START                                   45000

SHARE ASSEMBLER STATISTICS

TAPE   TOTAL      1 FAIL      2 FAIL      3 FAIL      4 FAIL
INP      905           0           0           0           0
LIB        0           0           0           0           0
COL      905           0           0           0           0

NUMBER OF ON-LINE INPUT RECORDS          0

NUMBER OF OFF-LINE PRINT RECORDS      1111                          USCOMM-DDC-OC

NUMBER OF SYMBOLS. DEF    241.DEFOP      0.UNDEF      0

                                                                        79
045022JL LAMKIN J          ON0228315 OFF0228561 AS TIME028559 AS
```

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National Bureau of Standards, Washington 25, D. C.
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